Beckman®

1453B DIGITAL PRINTER

OPERATING AND SERVICE INSTRUCTIONS

MP MASTER
MA31722

BII NO. 015-437861

1453B DIGITAL PRINTER

Beckman® INSTRUMENTS, INC.
ELECTRONIC INSTRUMENTS DIVISION
3900 RIVER ROAD
SCHILLER PARK, ILLINOIS • 60176

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IMPORTANT NOTICE

WARRANTY

Your instrument, covered by the warranty enclosed with this shipment, has been carefully made and rigidly inspected to insure that it will conform to the high standards of accuracy and dependability characteristic of all Beckman instruments. If properly used and maintained, the instrument should give superior service for many years.

SHIPPING DAMAGE

Each Beckman instrument is carefully examined and checked before it is shipped. Visually and operationally check your instrument as soon as it is received. If it is damaged in any way, a claim should be filed with the carrier. New or repaired instruments damaged in transit should not be returned to the manufacturer without first obtaining specific shipping instructions from the Electronic Instruments Division by calling (312) 671-3300.

EQUIPMENT RETURN

If any fault develops in your instrument, the following steps should be taken: Notify the Electronic Instruments Division of Beckman Instruments, Inc., giving full details of the difficulty. Include in the notification the model number and serial number of the affected instrument. On receipt of this information, Beckman will issue service or shipping instructions. If return of goods is authorized, forward the instrument prepaid, and repairs will be made at the factory. If the instrument is not covered by warranty, or if it is determined that the fault is caused by misuse, an estimate will be submitted for your approval before commencement of repairs.

PRINTER SPECIFICATIONS

GENERAL

Printout Column Capacity:

One to twelve columns. Individual column input modules required.

Column Format:

Input data may be printed in any activated column. Columns can be transferred, deactivated or added by changing plug-in module.

Printing Rate:

1.5 lines per second.

Accuracy:

Identical to data source.

Transfer Time:

Input data must be available for a maximum of 540 ms when printing black, and 870 ms when printing red.

Digital Printout:

Zero thru 9 and blank.

Character Dimensions:

0.071 inch wide by 0.114 inch high.

Line Spacing:

0.1375 inch center-to-center.

Paper:

Three and one-half inch wide standard calculator roll, fanfold (5-1/2 inch per fold), or pressure sensitive.

Ribbon:

Standard red/black fabric calculator, automatically reversed.

Dimensions:

Eight inches high (203 mm), eight inches wide (203 mm), sixteen inches deep (406 mm).

Weight:

20 lbs (9.1 Kg) net
32 lbs (14.5 Kg) shipping

Power:

115/230 Vac, 50 to 400 Hz, 60W (fused).

Environment:

0 to +50°C

INTERFACE REQUIREMENTS

Input Code Compatibility

Input modules are available for all common codes and voltage levels. (Refer to input module specifications.)

Column Suppression

Single line grounded for each column suppressed (3 mAmaximum, +10 volt open circuit); or removal of code module.

Internal Ground

Internal ground is isolated from chassis ground and can be biased +100 volts.

Print Command

Switch selectable for either integrated circuit or vacuum tube transistor logic levels.

Integrated Circuit Mode:	A transition from binary 0 (0 to ±0.4 volts) to binary 1 (+2.5 to +5 volts) for a minimum of 25 micro-seconds is required.
Vacuum Tube Transition Mode:	A transistor from binary 1 (-0.2 volts to +50 volts maximum) to binary 0 (-12 to -50 volts maximum) is required; 15 milliseconds minimum between print commands. Source resist-ance 1 megohm maximum.

Data Source Inhibit Signal

Produces a contact closure through a 220 ohm resistor to power ground within 2 milliseconds after receiving a print command. The inhibit signal will last until the coded input data is no longer required.

Color Control

Manual: Two position switch selects red or black print.

Remote Control:

Integrated Circuit Mode: Red logic 0 or ground, black logic 1 or open circuit.

Transistor/Vacuum Tube Mode: Red, 0 to 50 volts maximum; black, -10 to -50 volts maximum.

INPUT MODULE SPECIFICATIONS

AVAILABLE INPUT MODULES			
	4 Line	**10 Line**	**4 Line IC**
Input Logic Lead:	With 2 meg source Binary 0 = -10V to -50V Binary 1 = +0.8V to +50V With 10K source Binary 0 = -8V to -50V Binary 1 = -0.8V to +50V		Binary 0 = 0 to +0.4V Binary 1 = +2.5V to +5V
Input Code:	1 — 2 — 2 — 4, 1 — 2 — 4 — 8, -or- 1 — 2 — 4 — 2 BCD	1 Wire: Binary 1 9 Wires: Binary 0 also accepts BCD codes	1 — 2 — 4 — 8 BCD
Input Resistance:	10 meg (approx) — Negative Inputs 200 ohms — Positive Inputs		Binary 0: 1.4 mA flows from input code module Binary 1: Less than 5 μA flows from input code module

These Specifications are Subject to Change Without Notice.

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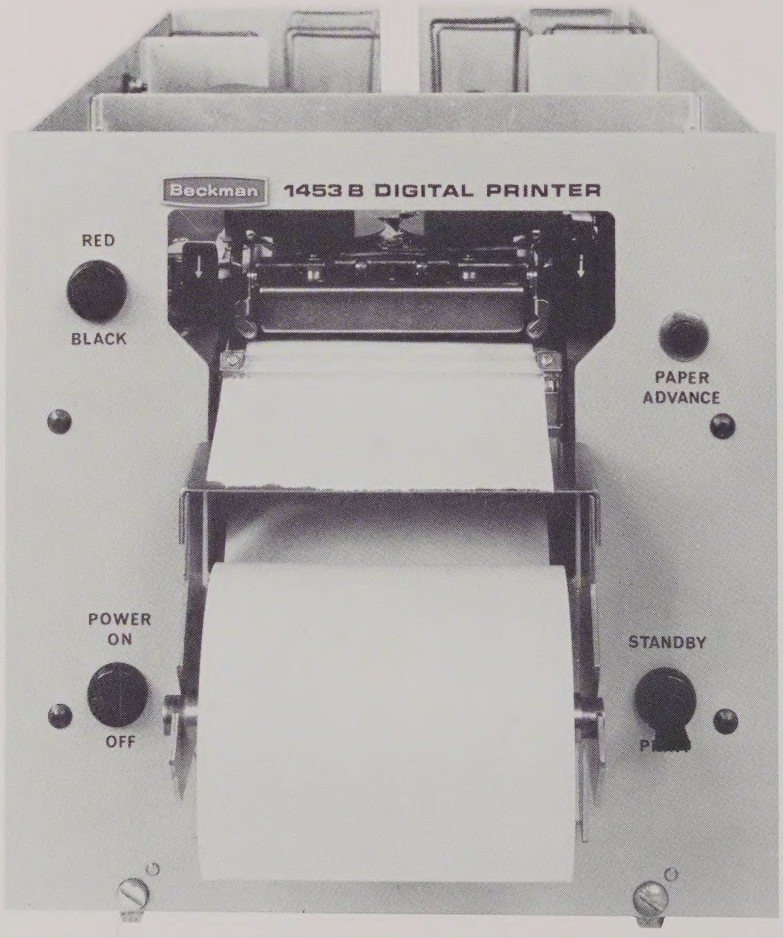

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1.1 INTRODUCTION

The Beckman Model 1453B Digital Printer (Figure 1) records digital data from a wide variety of program sources. The addition of plug-in modules provides flexibility of input codes, levels, and format to ensure instrument adaptibility to any application. These plug-in accessories include BCD or 10-line input; vacuum tube, transistor, or integrated circuit (IC) logic levels; and multiple source acceptance.

With printing speeds up to 1.5 lines per second, the Model 1453B Digital Printer is used with data sources such as digital voltmeters, counters, or data acquisition systems.

The Model 1453B was designed to replace the existing Beckman 1453 or 1453A Digital Printers. Replacement is accomplished by simply removing the input code modules from the older printers and installing them in the new 1453B. There is no need for redesign or change of the existing system Input Code Module. The 1453B is completely interchangeable with the 1453 both physically and electrically.

1.2 OPTIONS AND ACCESSORIES

The following supplies and accessories are included with your digital printer:

- Roll of standard paper
- Installed black/red ribbon
- Instruction manual

An optional fanfold adapter (449-437625) is available to handle 3-1/2 inch fanfold tape (Figure 2).

1.2.1 Input Modules

The following Input Modules are available and are supplied as optional equipment with your Basic 1453B Digital Printer (855-437850):

Part Number	Description
887-404453	10-line transistor/vacuum tube logic compatible module.
887-404459	4-line transistor/vacuum tube logic compatible module.
887-525701	4-line IC logic compatible module.

1.2.2 Optional Cables

Part Number	Description
664-404567	4-line cable for transistor or vacuum tube Beckman counters.
664-405888	10-line cable.
664-436034	4-line cable for 6100 and 6200 series IC counters.
664-437166	4-line cable for 6400 series IC counters.

1.2.3 Miscellaneous Options and Supplies

Part Number	Description
060-437639	Roll Tape — 24 rolls
060-437641	Fanfold Tray — 12 packs
060-437643	Ribbon, fabric, red/black — 5 spools
449-437625	Fanfold Adapter Tray

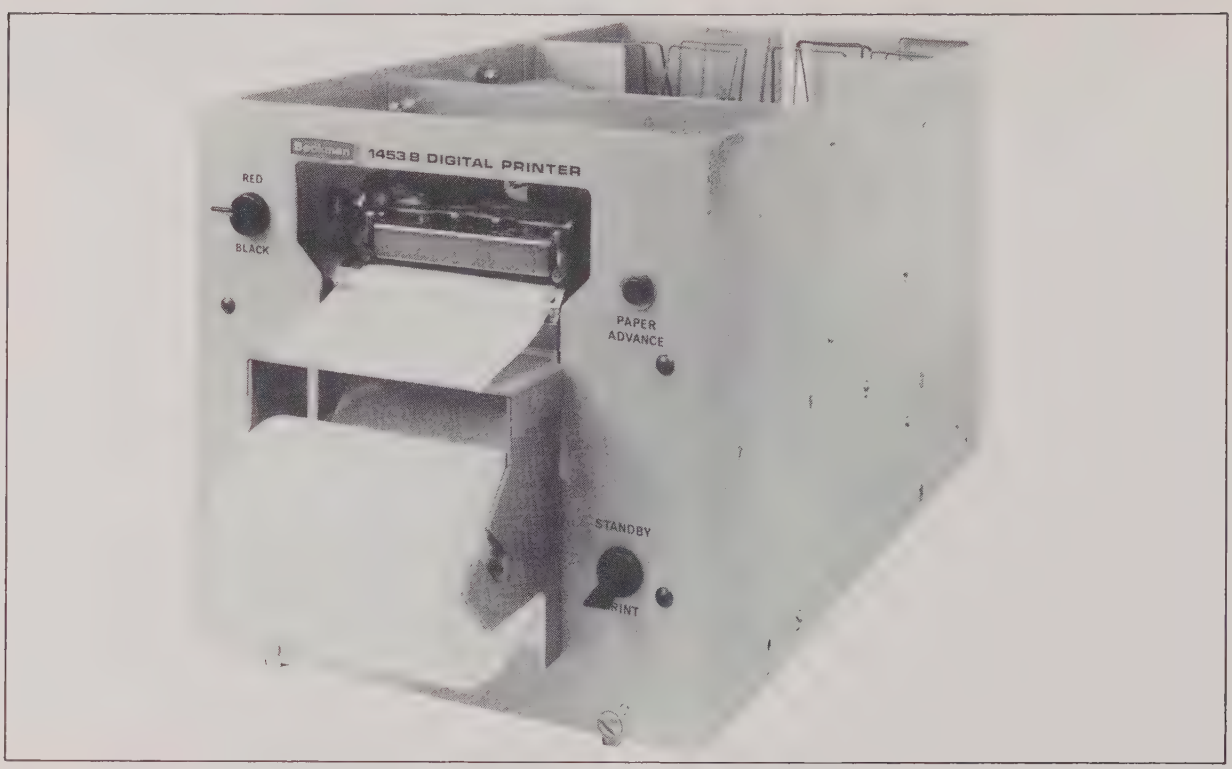


Figure 1. Beckman Model 1453B Digital Printer

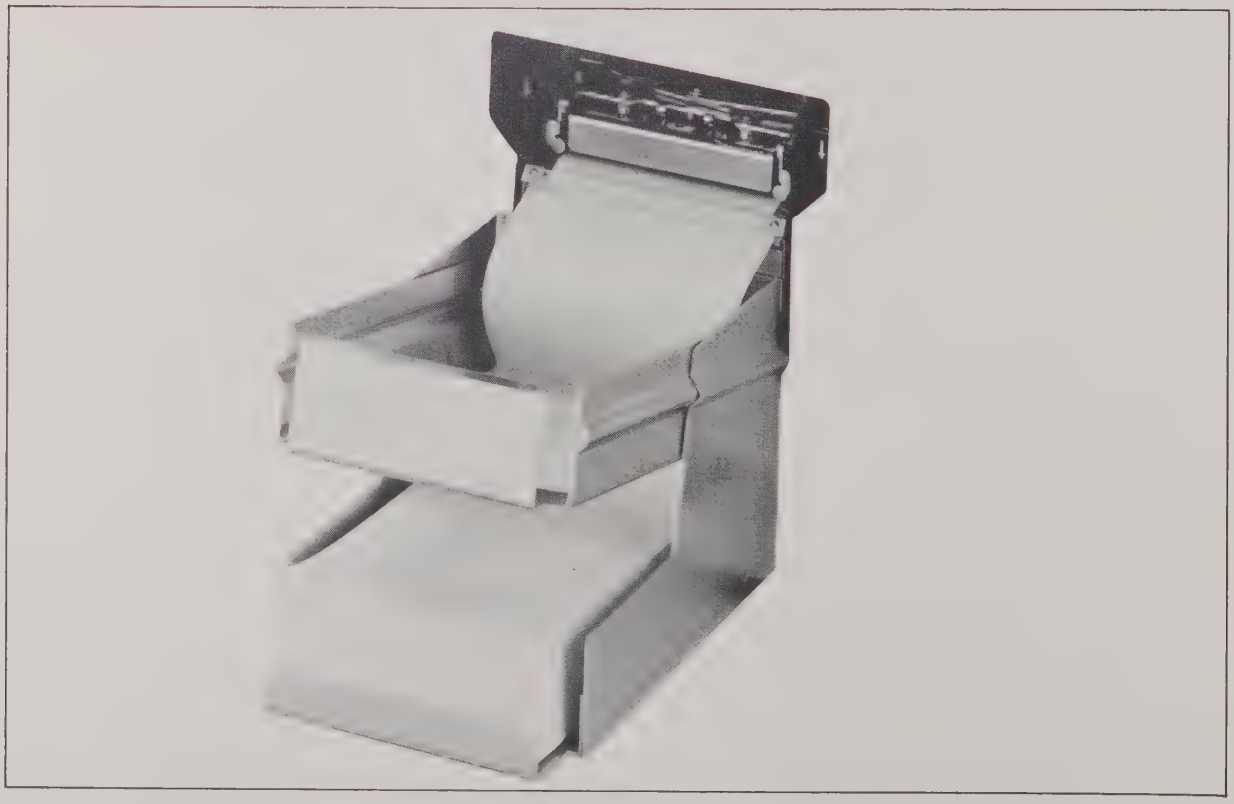


Figure 2. Fan Fold Adapter

2.1 UNPACKING AND HANDLING

Prior to careful packing and shipping, your Beckman Model 1453B Digital Printer was thoroughly tested and inspected. The instrument should be removed from the shipping carton with the same care accorded any precision electronic instrument. If the shipping carton showed any signs of damage, this fact should have been noted on the face of the transportation receipt, as described in the unpacking instructions that accompanied the shipping carton.

Remove the carton braces, and carefully remove the instrument from the carton. Do not discard the carton or packing material until the contents have been verified as complete and undamaged. Make a thorough visual inspection of the instrument and check for missing or damaged components. Verify the mechanical operation of all controls and switches — if damaged check condition of carton.

If any damage is apparent, call Beckman Instruments, Inc., Electronic Instruments Division, Customer Service Department, at area code (312) 671-3300, as soon as possible, for instructions.

CAUTION

Avoid storing the instrument in extreme temperature or humidity.

2.2 RESHIPMENT OF PRINTER

If, for any reason, it is necessary to return the instrument to Beckman, repack and ship according to the following instructions.

1. Wrap the instrument in polyethylene sheeting, and seal all sides.
2. Punch small air holes in the sheeting.
3. Wrap the instrument with rubberized hair and pack it into the shipping carton.
4. Include a note inside the carton explaining the reason the instrument is being returned, and the address for return shipment.
5. Seal the shipping carton and mark it clearly: "FRAGILE — HANDLE WITH CARE."
6. Address the carton to:

   Beckman Instruments, Inc.
   Electronic Instruments Division
   Customer Service Department
   3900 North River Road
   Schiller Park, Illinois 60176

7. Include your return address on the carton.

2.3 PREPARATION FOR INITIAL USE

Preparations for using the printer involves installation of the data input circuit modules, wiring the input cables, if required, and connecting ac power to the printer.

Before operating the digital printer, the following *PRECAUTIONS* should be observed:

Never attempt printing without inserting paper.

> Printing without paper for an extended period causes wear and damage to the print drum, the hammer, and the inked ribbon.

Never use printer in an environment where iron filings easily adhere.

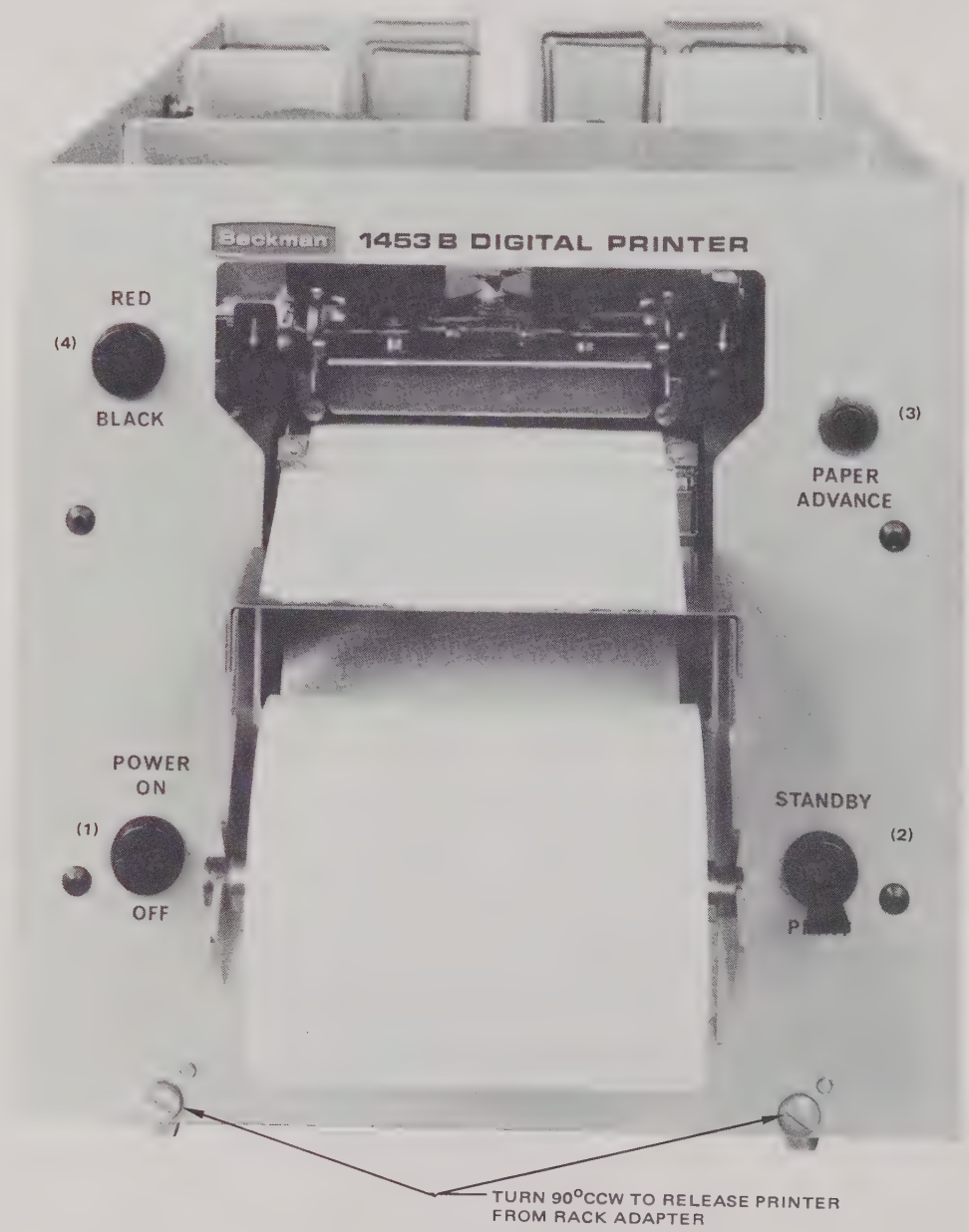
> With many permanent magnets and electromagnets in use, iron filings are easily attracted to the printer. Exercise care, especially when disassembling and assembling.

When printing is postponed over a long period, turn off printer power.

> The printer drum continues to rotate while power is applied to the instrument. Although the rotating gear wheel and the shaft are very durable, excessive continuous rotation causes the bearing parts to wear and produce noise.

2.4 FRONT PANEL CONTROLS

Figure 3 is a photograph of the front panel showing the operating controls and print mechanism. An explanation of each control and its function is summarized below the photograph.



1 POWER ON-OFF switch — Applies primary power to instrument.

2 STANDBY-PRINT switch — The PRINT position gives normal operation. The STANDBY position interrupts printout.

3 PAPER ADVANCE pushbutton — Paper advances 1/5 of an inch each time pushbutton is depressed. Paper advance is automatic during normal print cycle.

4 RED-BLACK print switch — Selects red or black printout; remote selection is available by grounding the external control line.

NOTE

When remote control is used, RED-BLACK print switch must be placed in BLACK position.

Figure 3. Front Panel

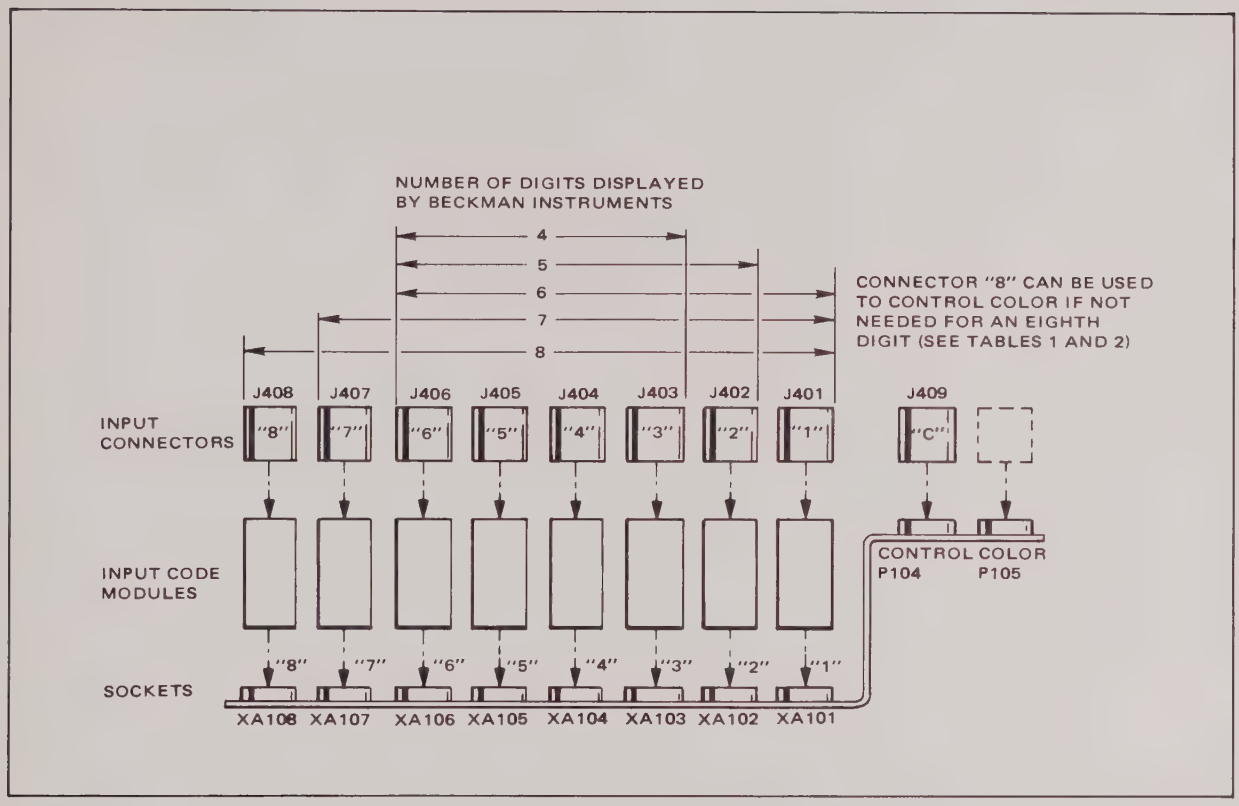


Figure 4. Typical Arrangement of Input Code Modules and Connectors

2.5 INSTALLING INPUT CODE MODULES

Follow the arrangement shown in Figure 4 when installing modules for use with Beckman data sources such as counters and digital voltmeters. With other sources, arrange the modules and connectors to meet requirements.

The twelve sockets marked XA101 through XA112 correspond to the twelve digit columns 1 through 12 (Figure 5). Connectors P104 and P105 are for CONTROL and COLOR, respectively. The printer can be supplied with seven four-line Input Code Modules and a main cable that is terminated in nine connectors marked 1 through 8 and C.

2.6 ELECTRICAL CONTROL

Two slide switches are located on the circuit board under the printer. When both of these switches are placed in the forward position, (toward front of printer), the electrical control selected is for the standard Model 1453 or vacuum tube logic levels. When both switches are pushed to the rear, the 1453B Digital Printer will function the same as a Model 1453A with an IC Control Module installed.

Table 1 shows the detailed printer functions with switches forward, and Table 2 shows the detailed printer functions with switches pushed to the rear.

2.7 CODE CONTROL WITH FOUR-LINE INPUT CODE MODULES

The code accepted with four-line modules depends on whether or not the code control line is grounded (Table 1). Beckman automatically provides the proper code control signal.

2.8 USING DECIMAL DATA WITH TEN-LINE INPUT CODE MODULES

Decimal input to a ten-line module is on nine lines, each wired to a separate pin, numbered 1 through 9 on the module connector (P201). Pin 10 is used for column suppression (Table 1). A binary 1 voltage on any one line represents the digit corresponding to the pin number. Binary 0 on all lines represents digit 0.

To operate the printer when all modules are ten-line:

1. Program printer for 1-2-4-8 code (Table 1).

2. Move switch on each module to position marked 1-2-4-8.

2.9 USING MIXED DECIMAL AND BCD DATA WITH TEN-LINE INPUT CODE MODULES

For mixed decimal and BCD data, proceed as follows:

1. Program printer for BCD code used (Table 1).

2. Place switch on each module receiving BCD input to 1-2-2-4 (regardless of code programmed).

3. Place switch on each module receiving decimal input to 1-2-2-4 or 1-2-4-8 (according to BCD code programmed).

2.10 USING BCD DATA WITH TEN-LINE INPUT CODE MODULES

BCD input to each ten-line module is on four lines, wired to pins 1, 2, 4, and 6 (corresponding to weights 1-2-2-4 or 1-2-4-8 , in that order) of module connector P201.

To operate the printer with BCD data:

1. Apply data to pins 1, 2, 4, and 6 of P201.

2. Connect pin 11 (a source of binary 0 bias) to pins 3, 5, 7, 8, and 9.

3. Set switch on each module to 1-2-2-4 regardless of the actual input code.

4. Program printer for 1-2-2-4 or 1-2-4-8, as described under Code Control in Table 1.

CONTROL SIGNAL	FUNCTION
Print Command	With standby-print switch at PRINT, a change from binary 1 to binary 0 at pin 5 of J409 starts a printing cycle. Binary 0 must be maintained for 100 milliseconds minimum to start the cycle. The print command line must return to binary 1 for at least 15 milliseconds before next cycle can be started. (Source resistance is one megohm, maximum.)
Code Control	Programs printer for input data of 1-2-2-4, 1-2-4-2, or 1-2-4-8 weighting (1-2-4-2 and 1-2-4-8 are the same to the Model 1453). A contact closure from pin 7 of J409 to power ground allows 1-2-4-2 or 1-2-4-8 data to be used. The printer responds to 1-2-2-4 code with pin 7 underground.
Inhibit Reset Command (Pin 1 of J409)	Inhibits data source from resetting until all data printing is complete (generated by the printer). Produces a contact closure through a 220 ohm resistor to power ground (occurs no more than 50 milliseconds after print command and lasts until the printer no longer needs the data.
Color Control	Permits electrical control of printing color. The RED-BLACK print switch must be at RED for electrical control of color. Binary 1 or open circuit at pin 6 of J409 produces a red impression; binary 0 a black impression.
Column Suppression	Produces a blank impression in the column controlled. A contact closure to power ground from pin 10 of the top connector (P201) of any module will suppress the column. Note that pin 10 of connectors 1, 2, 7, and 8 is wired to the main connector. Removing a module will also suppress the corresponding column.

Table 1. Electrical Control Functions — Switches Forward

CONTROL SIGNAL	FUNCTION
Print Command	1) Accepts positive-going IC level pulse from data source, 30 microsecond nominal. IC levels defined as: 0 = +0.45V 1 = +2.5 to +5.5V 2) Pulse can be as narrow as 1 microsecond or as long as desired with the following understanding:
Code Control	Programs printer for input data of 1-2-4-8 weighting.
Inhibit Reset Command	Inhibits data source from resetting until all data printing is complete (generated by the printer). Produces a contact closure through a 220 ohm resistor to power ground (occurs no more than 1 millisecond after print command and lasts until the printer no longer needs the data.)
Color Control	The printer is capable of red or black printout. Black printout is automatic and no external control is required, although an IC high level (Logic 1) can be on the color control line (pin 6 of P1). For red printout, pin 6 of P1 must be at ground IC logic 0. The color control signal can be continuously applied or applied only when a print command is issued. It should remain constant during the actual printing sequence.
Column Suppression	Produces a blank impression in the column controlled. A contact closure to power ground from pin 10 of the top connector (P201) of any module will suppress the column. Note that pin 10 of connectors 1, 2, 7, and 8, is wired to the main connector. Removing a module will also suppress the corresponding columns.

Table 2. Electrical Control Functions, Switches to Rear

2.11 IDENTIFYING CONNECTIONS TO INPUT CABLES

Wiring diagrams for the four-line and ten-line cables, respectively, are given in Section Five, Figures 48 and 51.

2.12 CONNECTING A DATA SOURCE

To use the printer with a Beckman Instrument, plug the input cable into the digital recorder socket on the instrument. This socket carries all the data and control signals needed for automatic operation of the printer.

When using the Model 1453B with Series 6200 and 6300 instruments. The two slide switches under the instrument must be switched to the rear (toward the back of the instrument).

For data sources other than Beckman Instruments, use the input cable schematic diagrams to determine appropriate cable connections (Section Five).

2.13 APPLYING POWER

Before connecting printer power cable, check to see that the POWER ON-OFF switch (Figure 4) is in the OFF position.

The digital printer is normally wired for 115 Vac operation. If 240 Vac operation is specified, the printer can be wired for this power requirement. The power plug will also be specially tagged to indicate the primary power amplitude and frequency requirement.

NOTE

When turning the printer off, place the STANDBY - PRINT Switch to STANDBY position before turning power off.

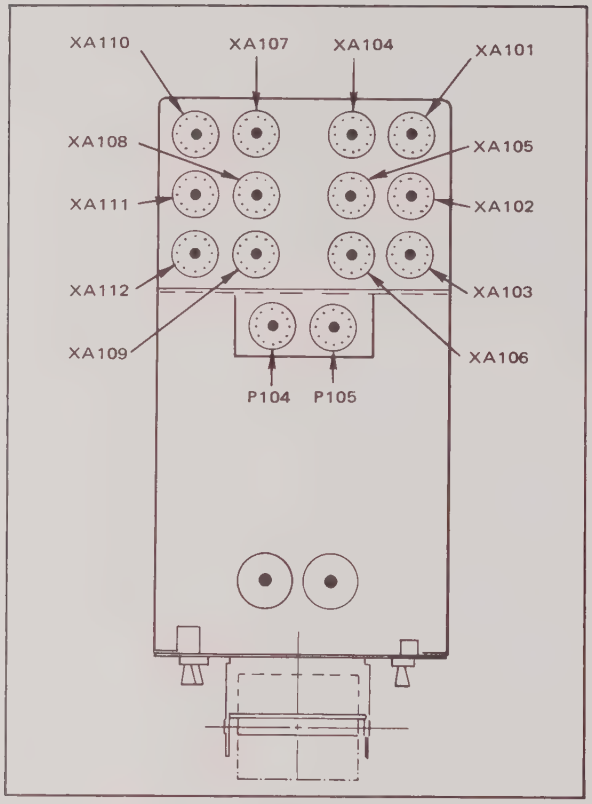


Figure 5. Socket Location Diagram

2.14 INSERTING PAPER TAPE

The end of the paper tape, whether roll or fanfold, should be cut to provide a smooth straight edge. This end should be pushed into the opening located below the printing drum assembly. When the paper is inserted as far in as it will go, the PAPER ADVANCE pushbutton should be pushed repeatedly until the paper advances through the print mechanism and back out the front. When the paper comes out the front, make sure it feeds under the clear plastic tear-off guide.

2.15 REPLACING PRINT RIBBON

Each printer is shipped with a new ribbon installed. When a ribbon needs to be changed, reach into the top of the opening of the front panel and pull the ribbon tray assembly out by pulling on the black tabs which are marked with white arrows.

Figure 6 illustrates ribbon threading. A small decal on the ribbon tray shows how to thread the ink ribbon correctly. Push the knob in the direction of the arrow to slide out ribbon spool assembly. After a new ribbon is installed, push the ribbon tray assembly back into the printer.

2.16 OPERATING PROCEDURE

With the input modules installed, input cables wired, power connected, and the paper tape loaded, the printer is ready for operation.

To operate the digital printer proceed as follows:

1. Place the STANDBY-PRINT switch in the STANDBY position.
2. Place the POWER ON-OFF switch to the ON position.
3. Select print color by placing RED-BLACK print switch in either the RED or BLACK position.
4. Place the STANDBY-PRINT switch in the PRINT position.
5. The printer is now in operation and should go through a print cycle when the selected data source print condition is present. If any difficulty is experienced refer to Section Four, Paragraphs 4.3 and 4.4.

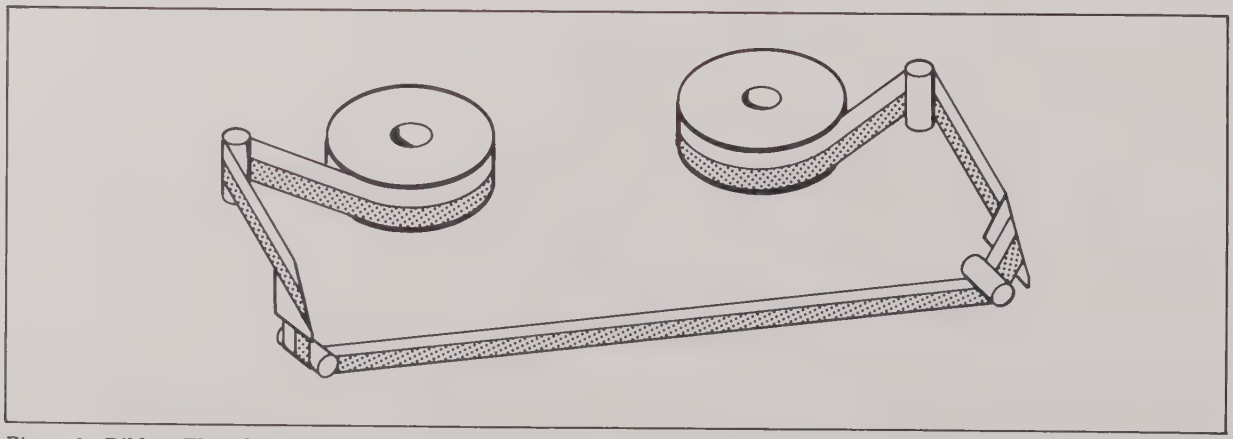


Figure 6. Ribbon Threading Diagram

3.1 GENERAL

Figure 8 is a simplified block diagram showing Model 1453B Digital Printer operation. A print cycle is started by an external print command signal. When a print cycle starts, the printer decodes the input data present and operates the print mechanism to print the equivalent input code. Upon print cycle completion, the printer stops and waits until the next print command signal is received.

3.2 PRINT MECHANISM

The print mechanism (Figure 9) is a type referred to as a flying printer because the print drum rotates continuously during operation. Printing is performed by selecting a print hammer corresponding to a character disposed on the surface of the drum. The complete mechanism consists of a dc motor driving the drum, 21 trip magnets for operating the print hammers, a ribbon advance solenoid, and a paper advance solenoid.

The 16 characters in each column are spaced equally around the print drum. To print a particular character, a trip magnet is actuated just before the preceding character passes under the print hammer. The trip magnet is turned off just before printing is completed, thereby completing a character print cycle.

The ribbon advance solenoid shifts the ribbon for printing in red and advances the ribbon. If the ribbon advance solenoid is energized before a print cycle starts, the ribbon tray is mechanically latched to hold the ribbon in position to print RED. When the paper advance solenoid is energized, the ribbon tray is mechanically released, and the paper advance solenoid advances 1/5 of an inch.

The print mechanism generates two timing signals: character position and drum position. The character position signal is called the *timing signal* and the drum position is called the *reset signal* (Figure 7).

The timing signal generates two pulses for each character position. The "TE" pulse is the time to energize the trip magnet to print a character and "TR" is the time to release the trip magnetic when printing a character. The reset signal occurs once for each drum rotation and coincides with the "TR" pulse for character position 15. These timing signals are used to generate a BCD code which corresponds to the drum position and a synchronized print enable signal to control energizing the trip magnets at the proper times.

3.3 FUNCTIONAL BLOCK DIAGRAM AND PRINT CYCLE FLOW DIAGRAM

Figure 10 is a functional block diagram for the 1453B Digital Printer. The printer consists of the following major assemblies: Code Input Modules, Print Mechanism, Master Printed Circuit Board, and Power Supply. Figure 11 is a print cycle flow diagram for the 1453B Digital Printer.

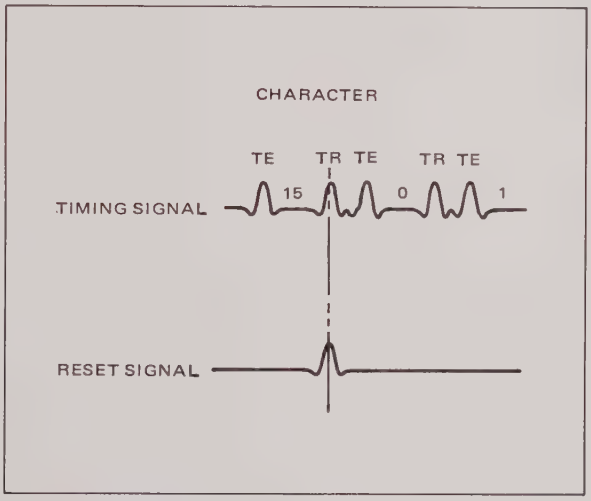


Figure 7. Print Mechanism Timing Signals

3.4 TIMING GENERATOR

The timing generator provides the required timing signals for printer operation. Circuits that shape the reset signal and timing signal from the Print Mechanism are also included in the timing generator.

The reset signal is amplified and shaped by a transistor circuit Q1, Q2, and Q3. The output of transistor Q3 provides a positive going pulse of about 5 volts in amplitude each time the character drum arrives at position 15. The signal output of transistor Q3 is applied to inverter Z1, pin 3. The negative going reset signal output Z1, pin 4 is used to reset the other timing circuits, clear the code generator, and initiate a print cycle.

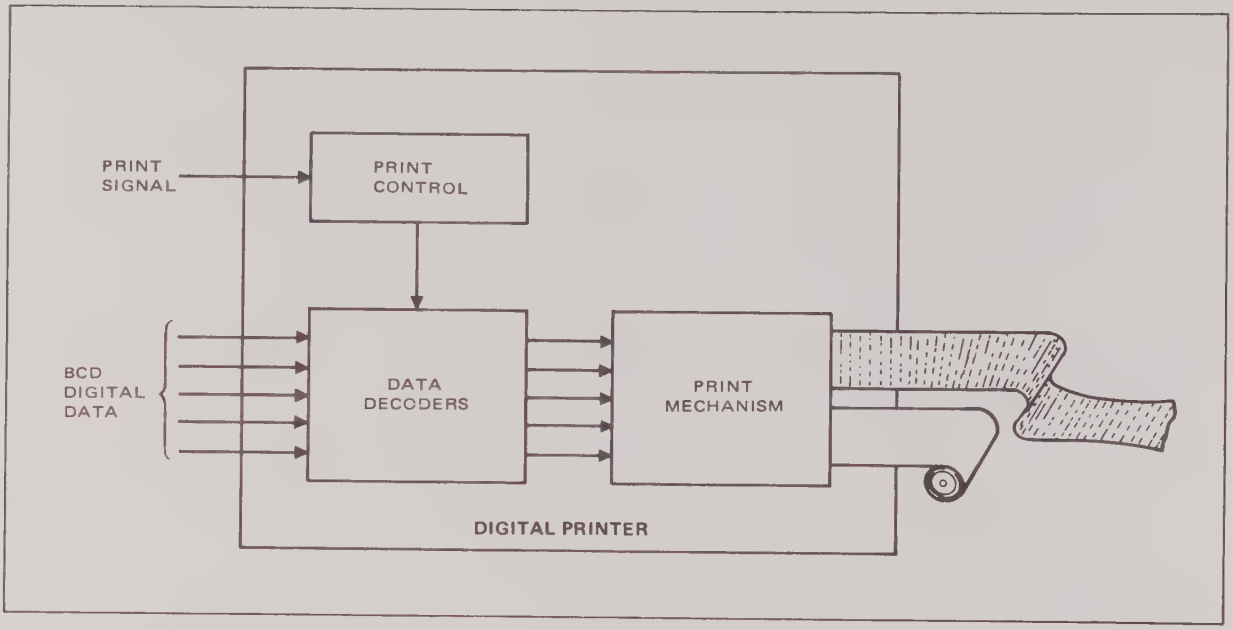


Figure 8. Digital Printer Simplified Block Diagram

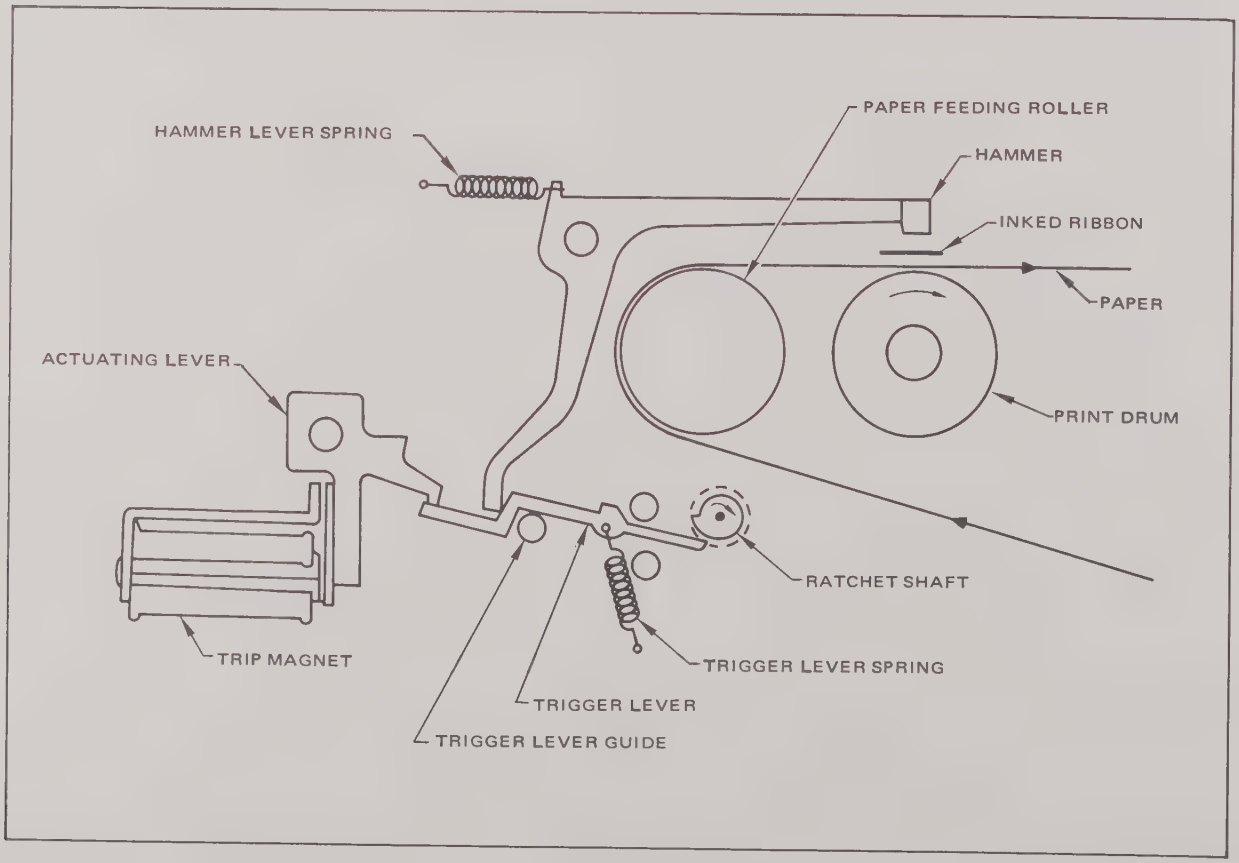


Figure 9. Print Mechanism

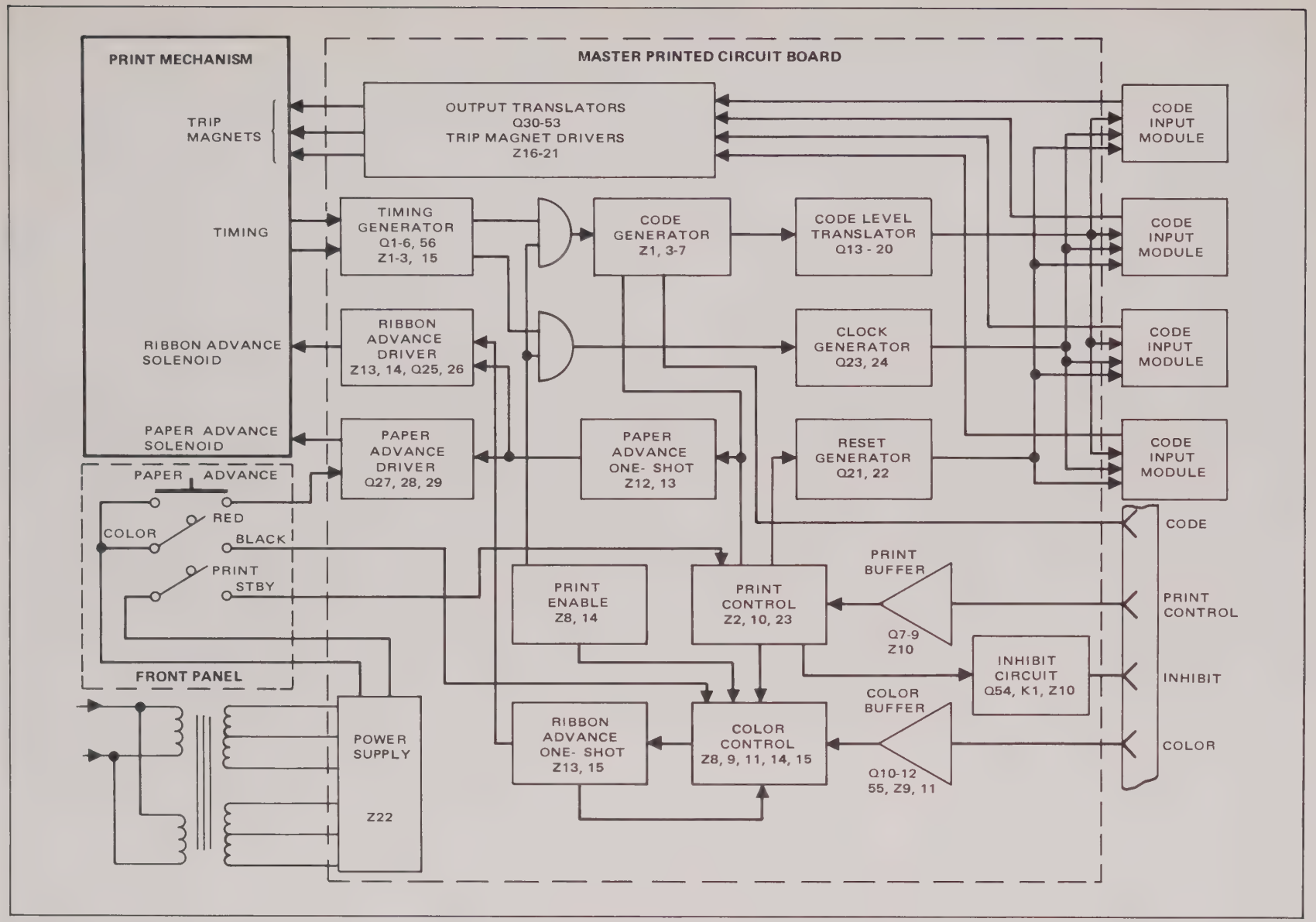


Figure 10. Digital Printer Functional Block Diagram

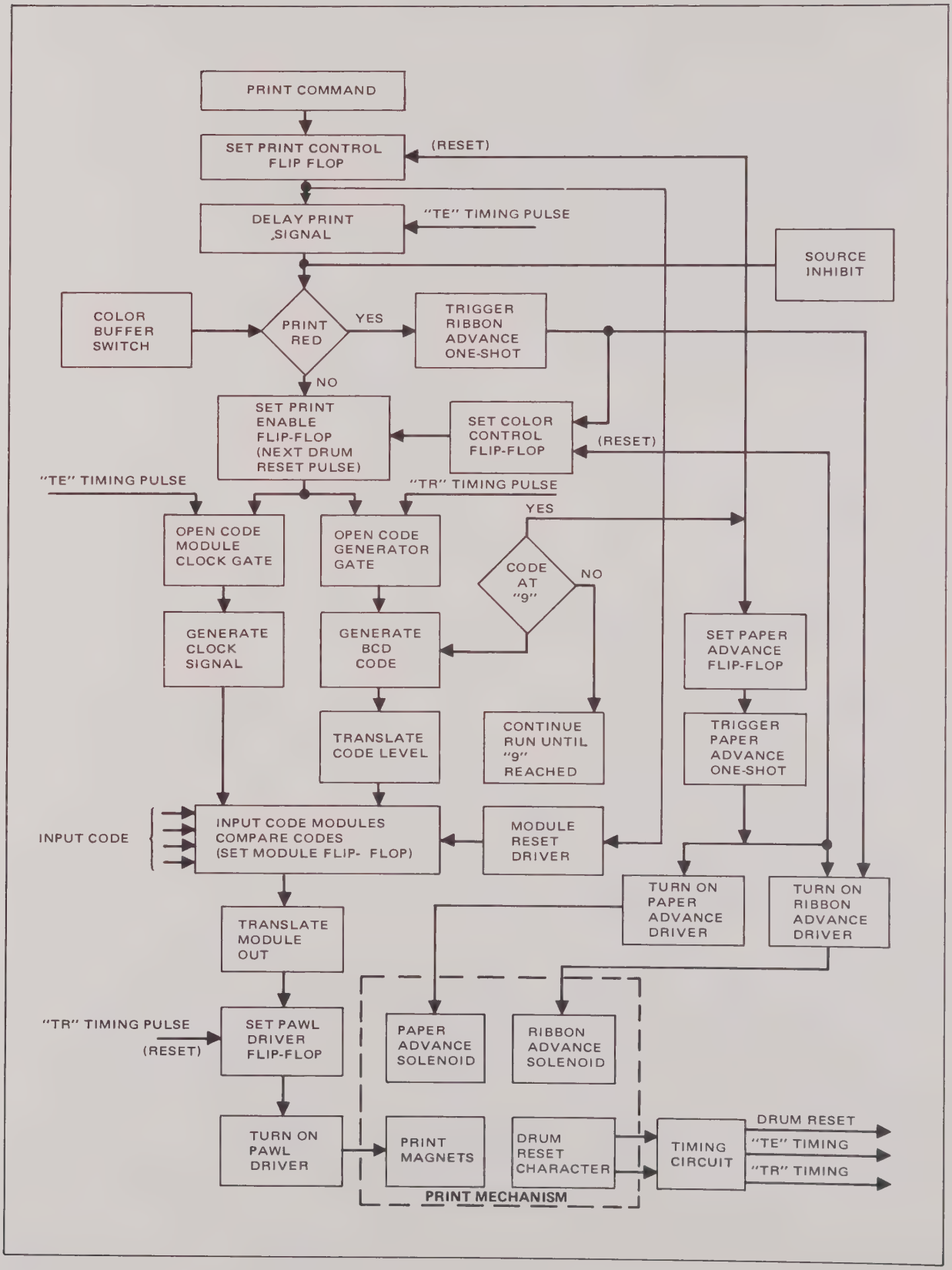


Figure 11. Digital Printer Print Cycle Flow Diagram

The timing signal from the print mechanism is applied to a similar shaping circuit consisting of transistors Q4, Q5, and Q6. This signal is connected to inverter Z1, pin 5. The output Z1, pin 6 is applied to Z2, pin 5, a J-K flip-flop. J-K flip-flop Z2 divides the input by 2. The reset signal Z1, pin 4, is also applied to flip-flop Z2.

Each revolution of the printing drum synchronizes the flip-flop to maintain the correct phase. The outputs of flip-flop Z2 are combined with the timing signal output of Z3. Figure 12 illustrates these signals in a timing diagram. Three signal outputs shown in the diagram are used in other circuits for printing: Z1, pin 4; Z3, pin 8; and Z3, pin 11.

3.5 CODE GENERATOR

The code generator consisting of gates and flip-flops Z1 through Z7 operates only during a print cycle. (Figure 13 is a simplified schematic of the code generator, and Figure 14 shows the code generator timing diagram.) The binary code generated, either 1-2-2-4 or 1-2-4-8, is synchronized with the print drum and sent to the Input Code Modules for comparison. The state of the code control line determines which binary code is generated. If the control line is grounded the code generated becomes 1-2-4-8. This is done automatically when switch S-6 is in the I.C. position.

At the end of the count of "9" the next clock pulse causes flip-flop Z2 outputs 13 and 12 to change state. These signals reset the print control circuit and also trigger the paper advance one-shot (Paragraph 3.13) to complete a print cycle.

3.6 CODE LEVEL TRANSLATOR

There are four code level translators used to convert the output logic level of the code generator to a logic level required for comparison by the Input Code Modules (Figure 15). The input signal is the standard TTL IC logic level and the outputs are -0.5 volt and +8 volts.

3.7 CLOCK GENERATOR

The clock generator (Figure 16) of the Input Code Module generates clock pulses during the print cycle to interrogate the Input Code Modules for code comparison. The clock pulses occur after the code generator code has been changed.

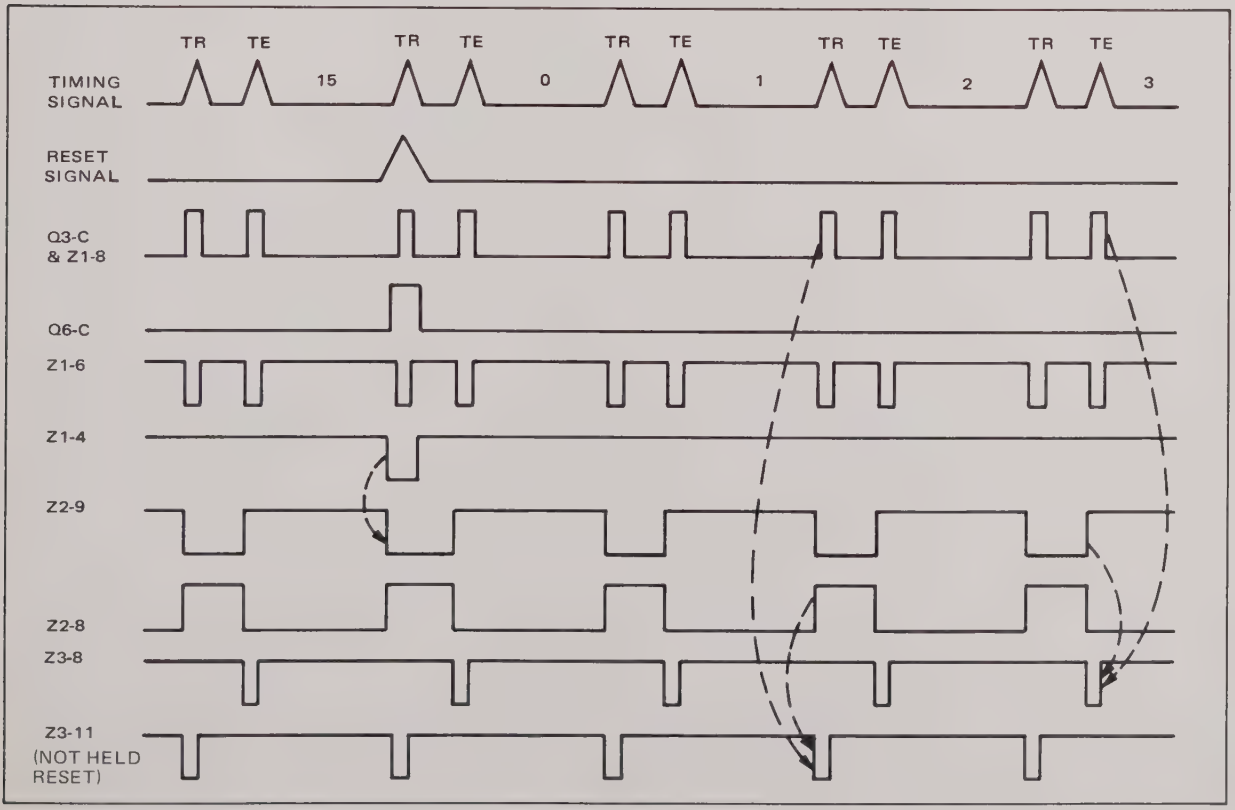


Figure 12. Timing Generator, Timing Diagram

The clock generator pulses are gated on and off by the same signal which controls the code generator.

3.8 RESET GENERATOR

At the end of the print cycle, the reset generator (Figure 17) produces the reset pulse that resets the flip-flop stage in each Input Code Module. The reset signal is preset until the next print command signal is received.

Three components, C45, R106 and CR28 are used to turn the reset generator on for a short time when power is applied to the printer.

3.9 PRINT BUFFER

The print buffer (Figure 18) is connected to the source print command, and in the STD logic position has an input impedance of one megohm. The print command is connected to the standard TTL IC logic level. When the output Pin 8, of Z10 is in the low or off state (logic "0"), a print cycle is initiated.

3.10 COLOR BUFFER

The color buffer circuit (Figure 19) is connected to the source color select signal and to the front panel RED-BLACK print switch S3. The standard color buffer circuit has an input impedance of one megohm. If the output of Z9, Pin 8 changes to a "0" logic level, the printer prints RED. If the logic level is a "1" the printer prints BLACK. The color

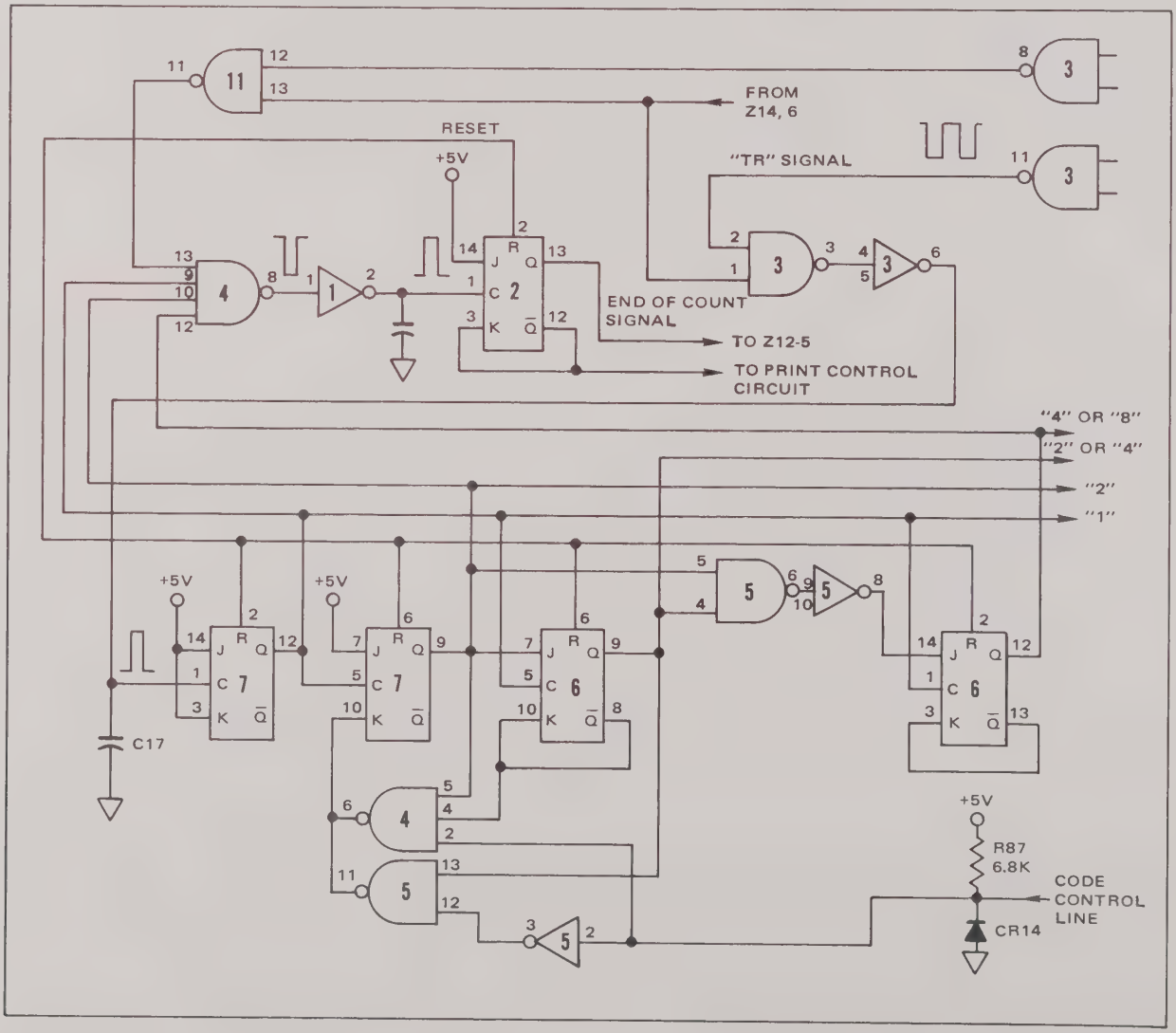


Figure 13. Code Generator Circuit

buffer is used only during the "REG." mode of operation.

3.11 OUTPUT TRANSLATOR-TRIP MAGNET DRIVER

This circuit (Figure 20) is connected to the output of each Input Code Module and times the turn on of the print mechanism trip magnets for proper printing. The output stage of the Input Code Module turns off when a code comparison occurs. This causes transistor Q1 to turn on and the "C" input to J-K flip-flop Z1 to change to the OFF state. The J-K flip-flop changes state causing transistor Q2 to conduct and energize the trip magnet in the print mechanism. At the time the trip magnet should be de-energized, a reset signal is applied to the flip-flop causing it to return to the OFF state. Since the "C" input is still low, it cannot be turned on again until the Input Code Module is reset.

The flip-flops are always held reset by Q57 until the printing starts; then the normal timed reset signal is present and continues for one character period after end of count.

The printer has 12 of these circuits, one for each Input Code Module installed.

3.12 PAPER ADVANCE DRIVER

The paper advance driver circuit (Figure 21) is used to activate the paper advance solenoid in the print mechanism.

The signals to operate this circuit are at a logic level "1" and are applied to the base of transistor Q27. This circuit can also be operated by pressing the PAPER ADVANCE pushbutton on the front panel and thus grounding the collector of transistor Q27. Large transient "spikes" are suppressed by resistor R58 and capacitor C6 in series across the paper advance solenoid.

When transistor Q27 conducts, the collector voltage approaches zero for the recycle duration. This causes capacitor C5 to discharge through resistors R55 and Q27. When transistor Q27 turns off at the end of the recycle signal, the low voltage remaining on C5 allows transistors Q28 and Q29 to conduct longer until C5 is recharged. This delay circuit causes the paper advance drive signal to be of longer

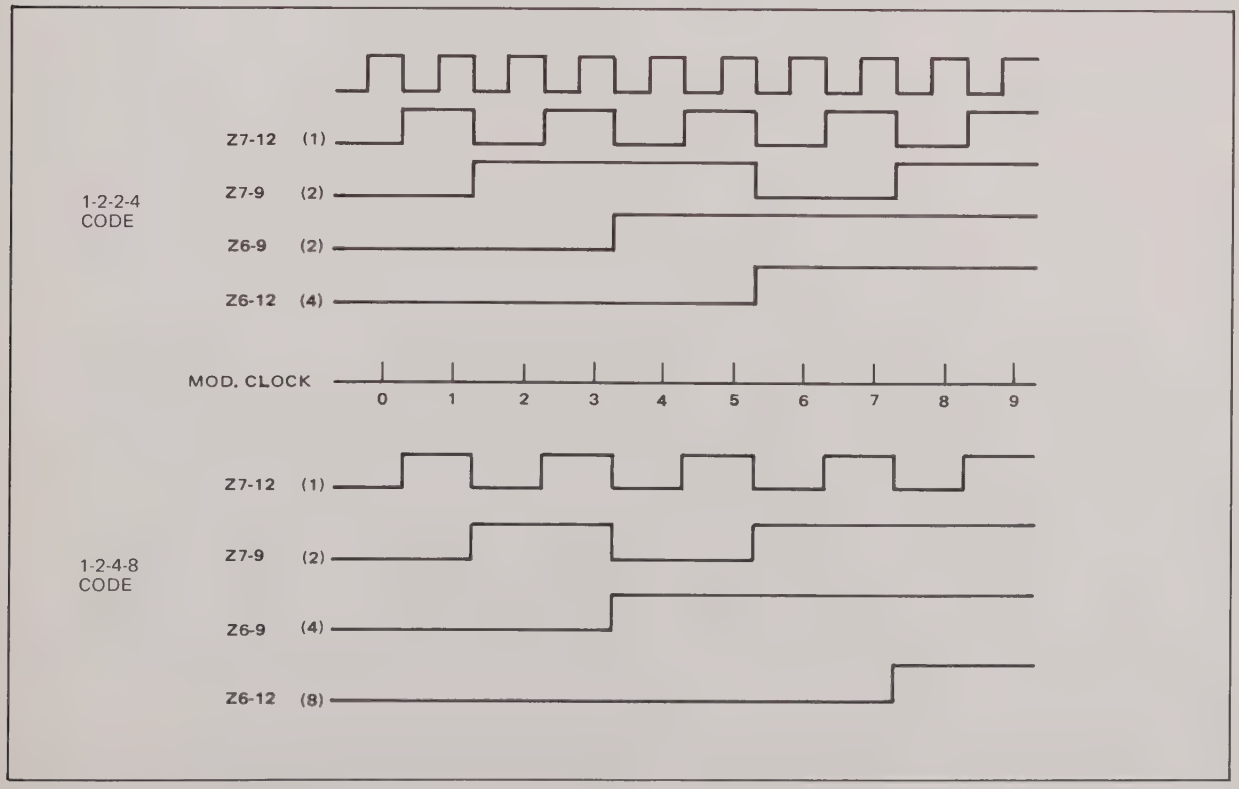


Figure 14. Code Generator Timing Diagram

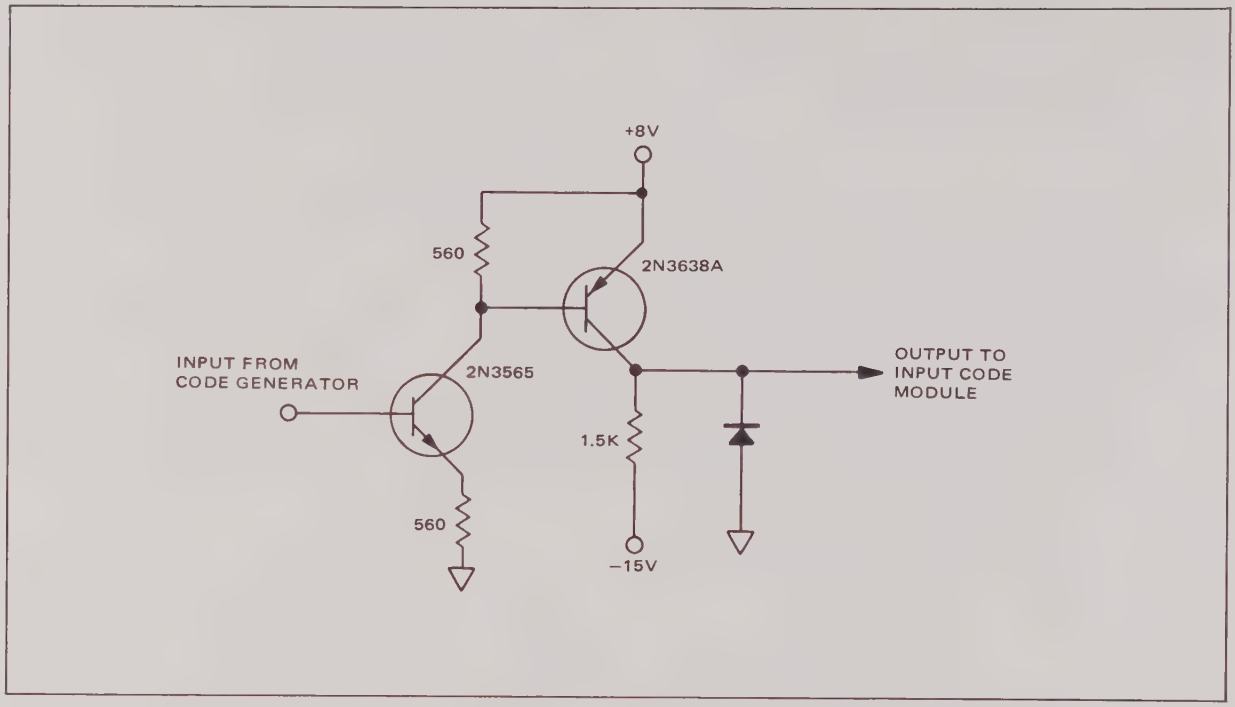


Figure 15. Typical Code Level Translator Circuit

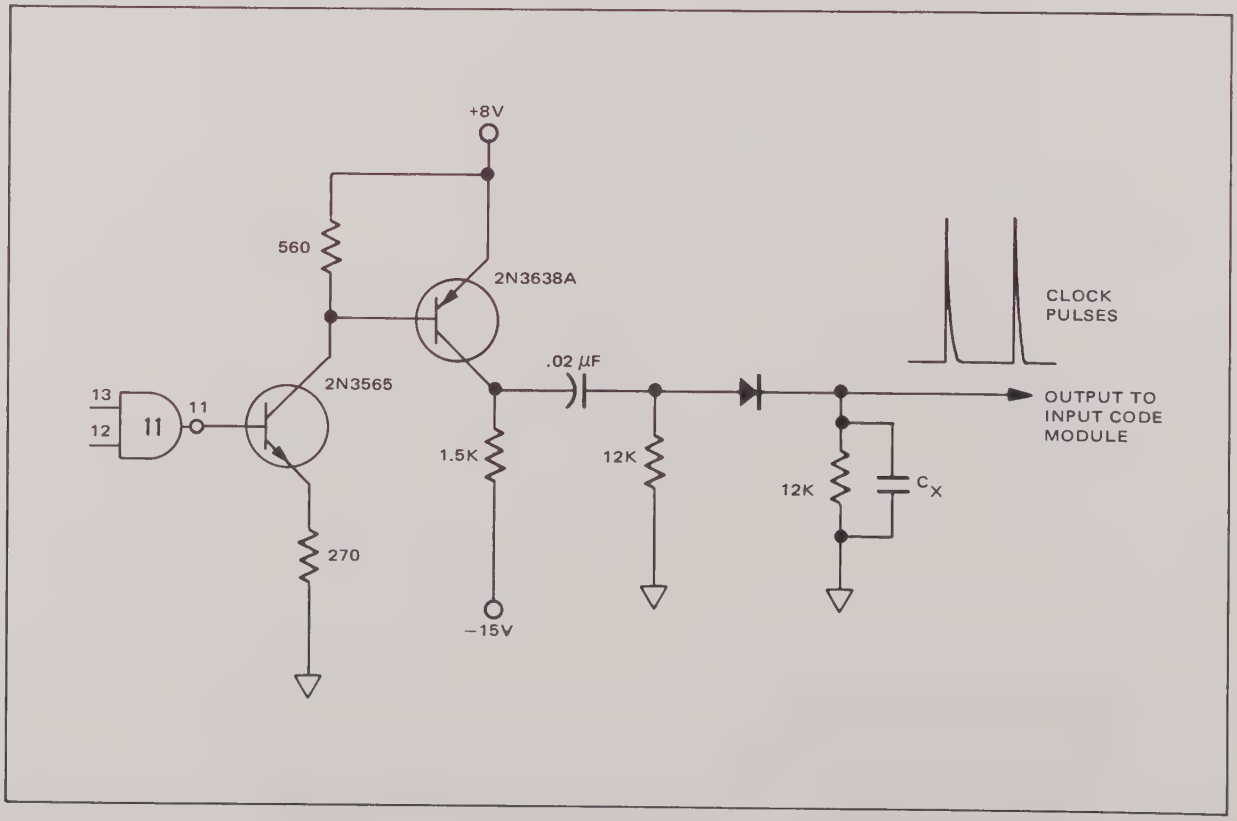


Figure 16. Clock Generator Circuit

duration than the ribbon advance drive signal. A longer duration paper advance signal is required to mechanically release the ribbon advance tray.

3.13 PAPER ADVANCE – ONE-SHOT

The paper advance — one-shot circuit (Figure 22) consists of two R-S flip-flop circuits and a one-shot multivibrator circuit. The end-of-count signal from the code generator to Z12, pin 5, enables this flip-flop to be triggered on the next "TR" signal from Z3, pin 11. When the Z12 flip-flop changes state, it triggers the one-shot circuit Z13. The output on Z13, pin 3, causes the output of R-S flip-flop Z12, pin 3 to go to the high state for the entire duration of the one-shot period. The one-shot flip-flop is not reset until the next "TR" signal from Z3, pin 11, comes along. The paper advance signal is applied to the ribbon advance driver.

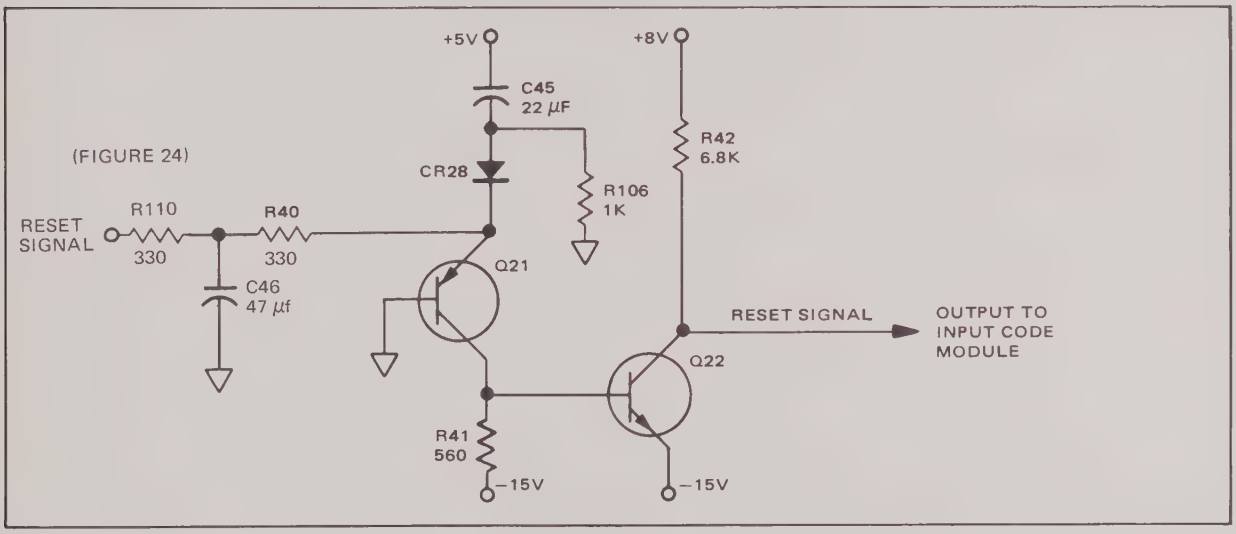


Figure 17. Reset Generator Circuit

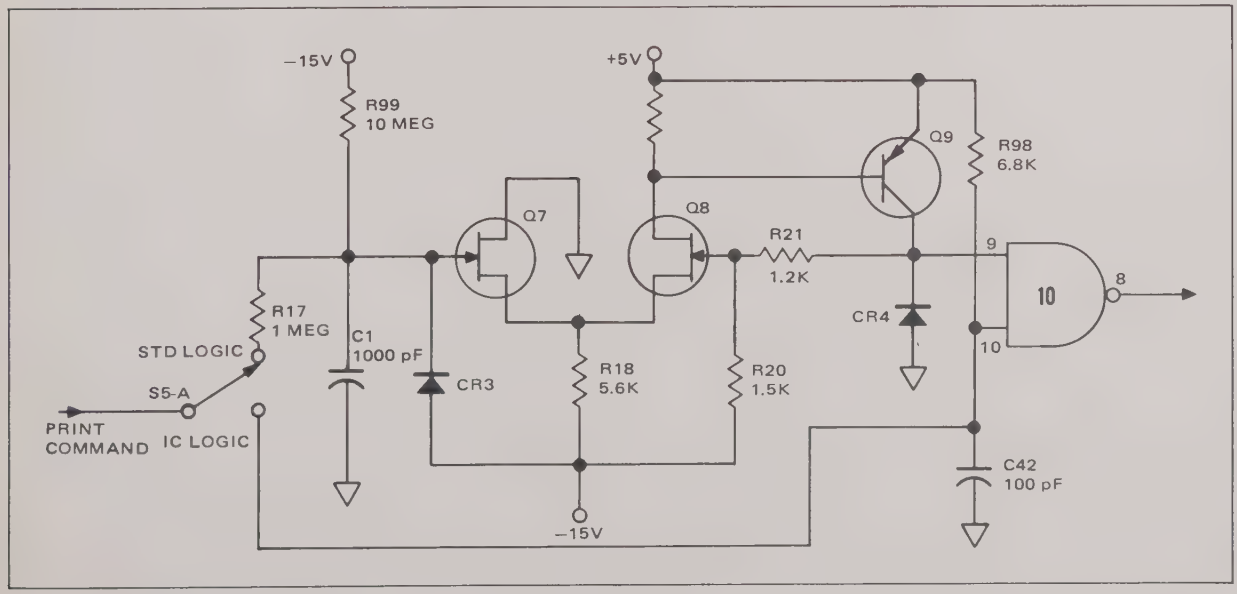


Figure 18. Print Buffer Circuit

3.14 RIBBON ADVANCE DRIVER

The ribbon advance driver circuit (Figure 23) is used to operate the ribbon advance solenoid in the Print Mechanism. There are two signals which can cause ribbon advance. If the printer is programmed to print RED, either locally or remotely, the ribbon advance driver must be operated before the print cycle takes place. This advances the ribbon tray forward to expose the red ribbon to the print hammers.

The ribbon advance driver is also turned on during recycle. Large transient "spikes" are suppressed by resistor R51 and capacitor C4 in series across the ribbon advance coil.

3.15 PRINT CONTROL

The print control circuit (Figure 24) is an R-S flip-flop connected to the print command buffer. This flip-flop changes state when the print command buffer is supplied with a print command signal. The output of the print control flip-flop is applied to the inhibit circuit, to the module reset generator, and also to Z23, a dual J-K flip-flop arranged to produce a delayed print signal. The delay equals the time required to count two "TE" timing pulses. The print control flip-flop remains set until the printer has completed a print cycle. When the coded input data is no longer needed, the code generator generates a reset signal to the print control circuit.

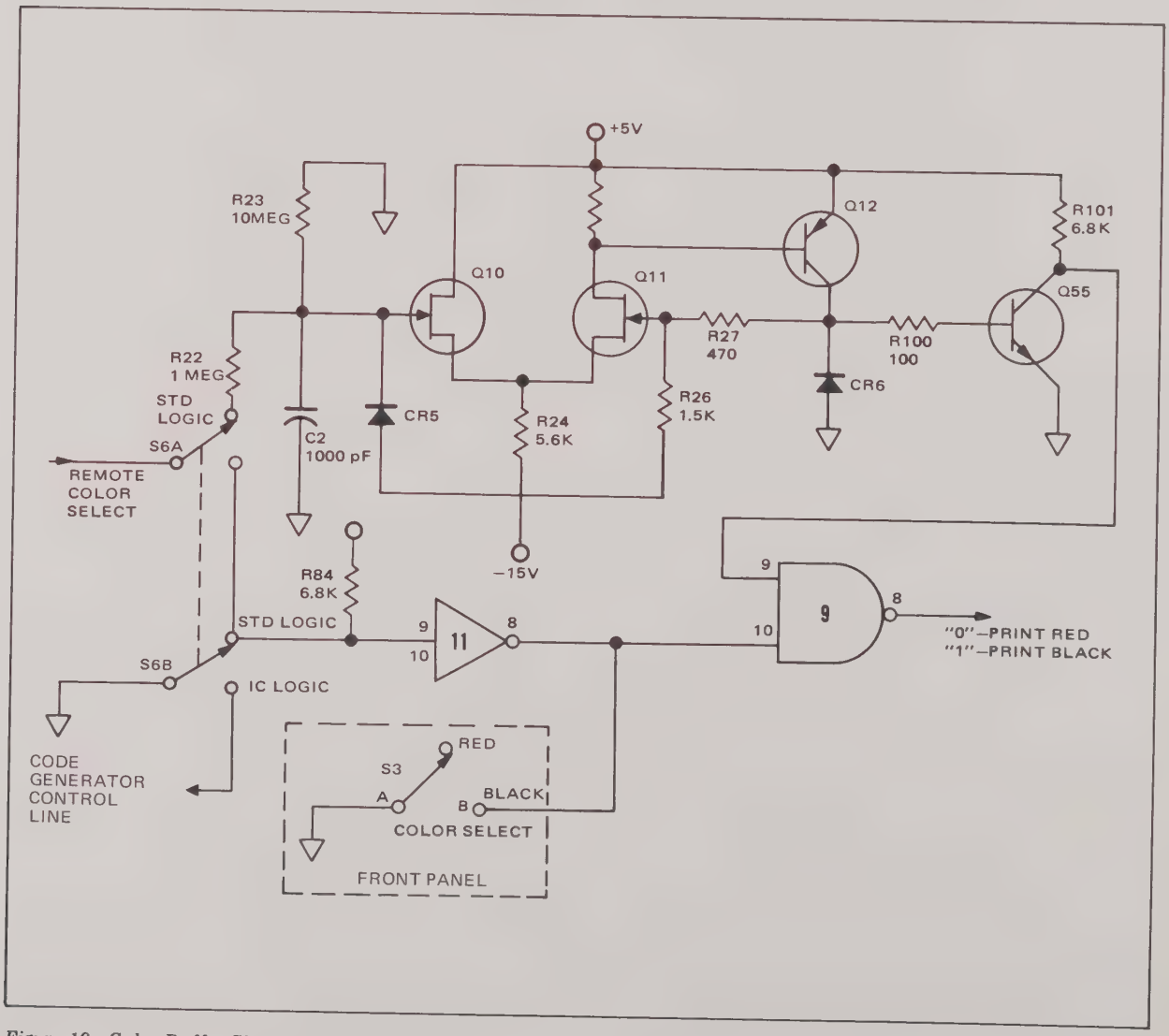


Figure 19. Color Buffer Circuit

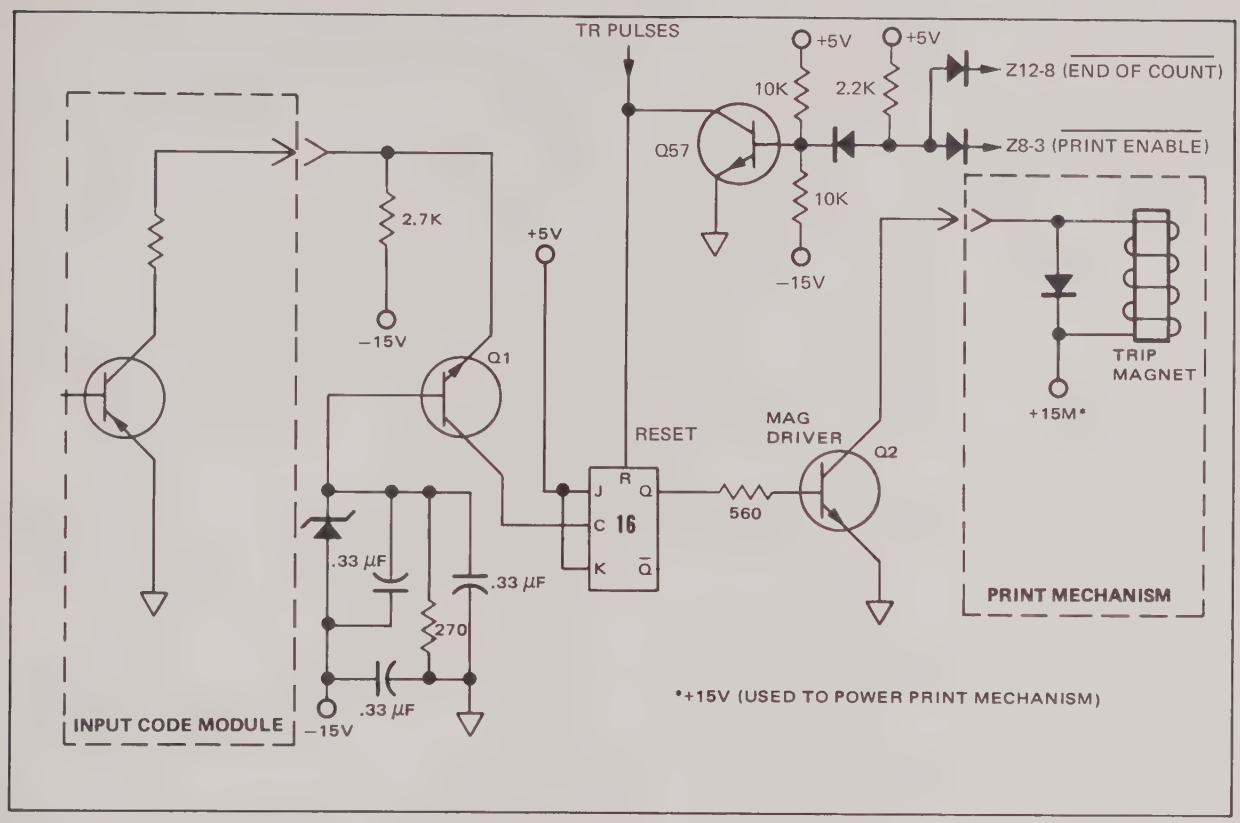


Figure 20. Typical Output Translator-Trip Magnet Driver Circuit

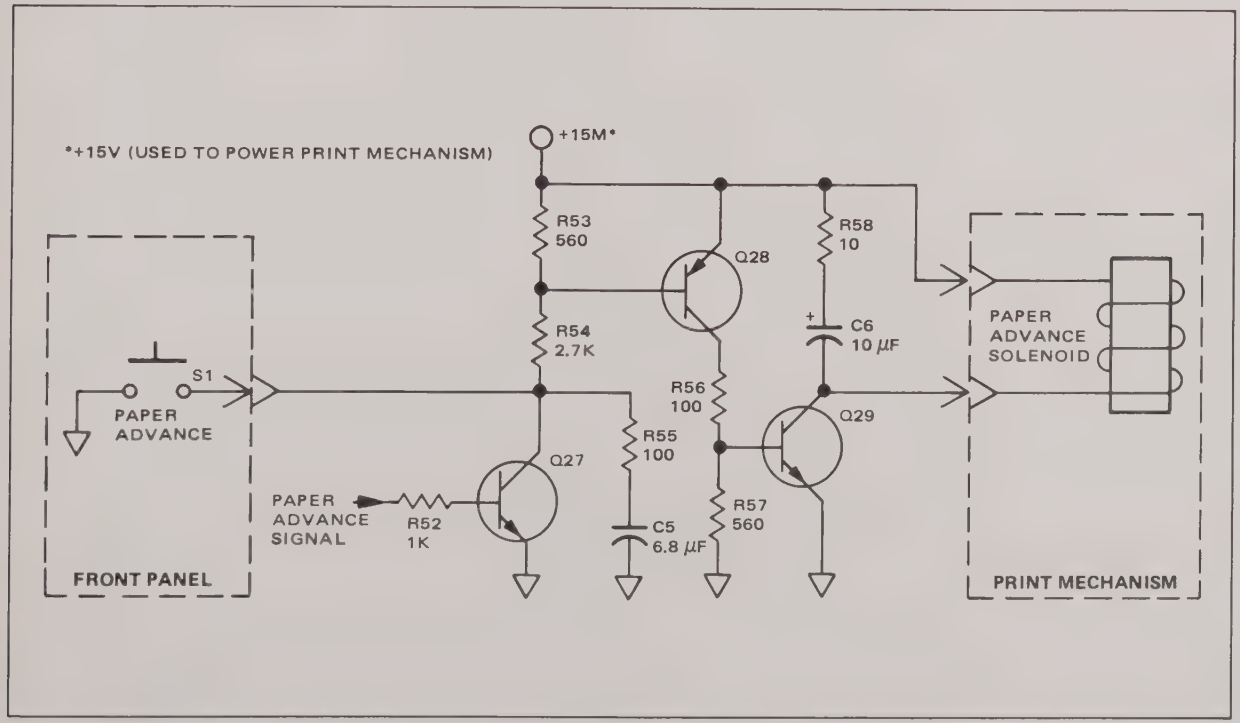


Figure 21. Paper Advance Circuit

Because the print buffer is AC coupled to the print control circuit, a steady state print command signal does not cause continuous printing. When the STANDBY-PRINT switch on the front panel is placed in the STANDBY position, the print control circuit cannot be set to start a print cycle.

3.16 COLOR CONTROL – PRINT ENABLE

The color control — print enable circuit (Figure 25) is the origin of the synchronized print cycle. The print control signal is combined with the output of the color buffer signal. If a print black signal is present, the resultant signal causes the print enable R-S flip-flop Z8 to change state when the next drum reset signal is present. This flip-flop in turn generates a print enable signal to control the code generator gate and Input Code Module clock gate.

If a print RED signal is present, a paper advance signal is required before a print enable signal can be generated. The combined print RED color signal and print control signal trigger the one-shot multivibrator Z13 and Z15 to provide a paper advance signal. The trailing edge of the paper advance signal triggers the R-S flip-flop Z14 causing it to change state. The output Z14, pin 11 then enables the print enable circuit to change state on the next drum reset signal, thereby initiating the print cycle.

3.17 INHIBIT CIRCUIT

During the print cycle, the inhibit circuit (Figure 26) provides a contact closure to signal ground through a 220 ohm resistor, R105. When S5B is switched from the STD logic mode to the IC logic mode, a standard IC buffer Z10 is connected in parallel with the contact closure to provide direct IC circuit interface to the data source.

3.18 POWER SUPPLY

The power supply (Figure 27) consists of five separate outputs. They are +15V, -15V, +8V, +5V (regulated), and +15M (an unregulated +15 volts used to power the Print Mechanism).

All supply voltages are full wave rectified with capacitive filtering. The regulated +5V supply uses the unregulated +8 volt source which is regulated to +5V by Z22. The tab on Z22 is bolted to the chassis to provide an adequate heat sink.

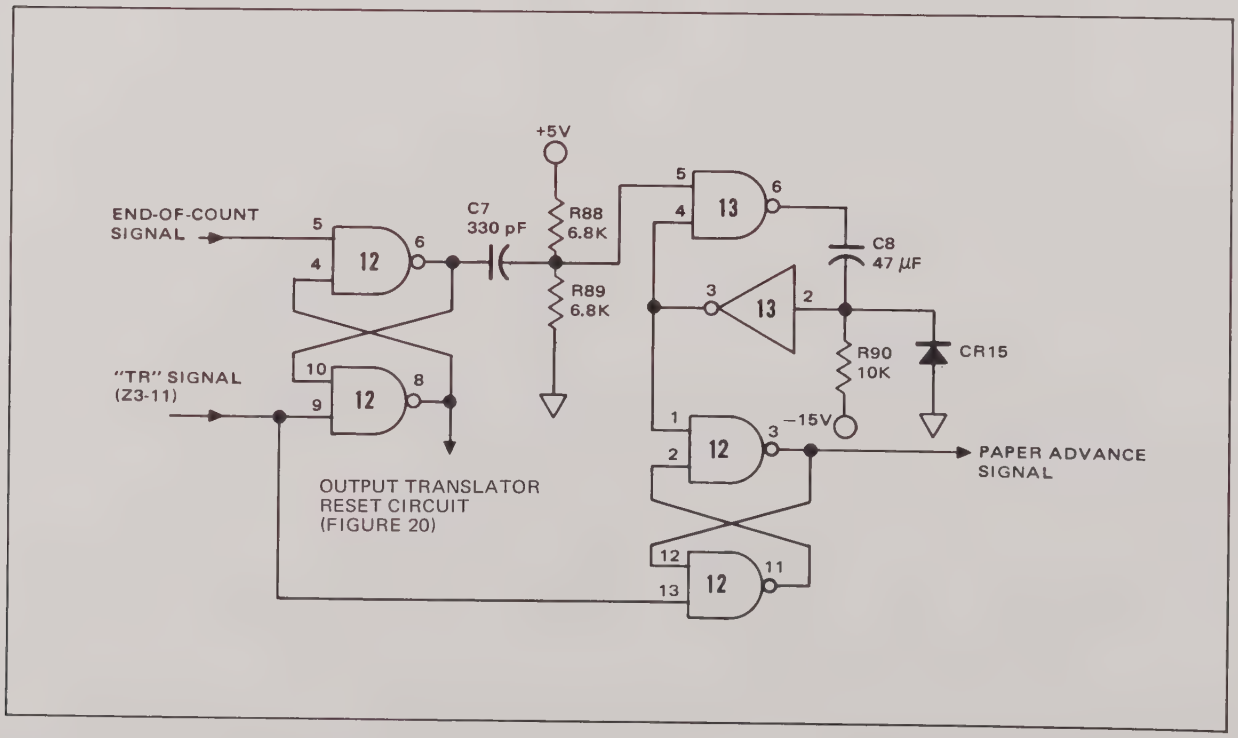


Figure 22. Paper Advance — One-Shot Circuit

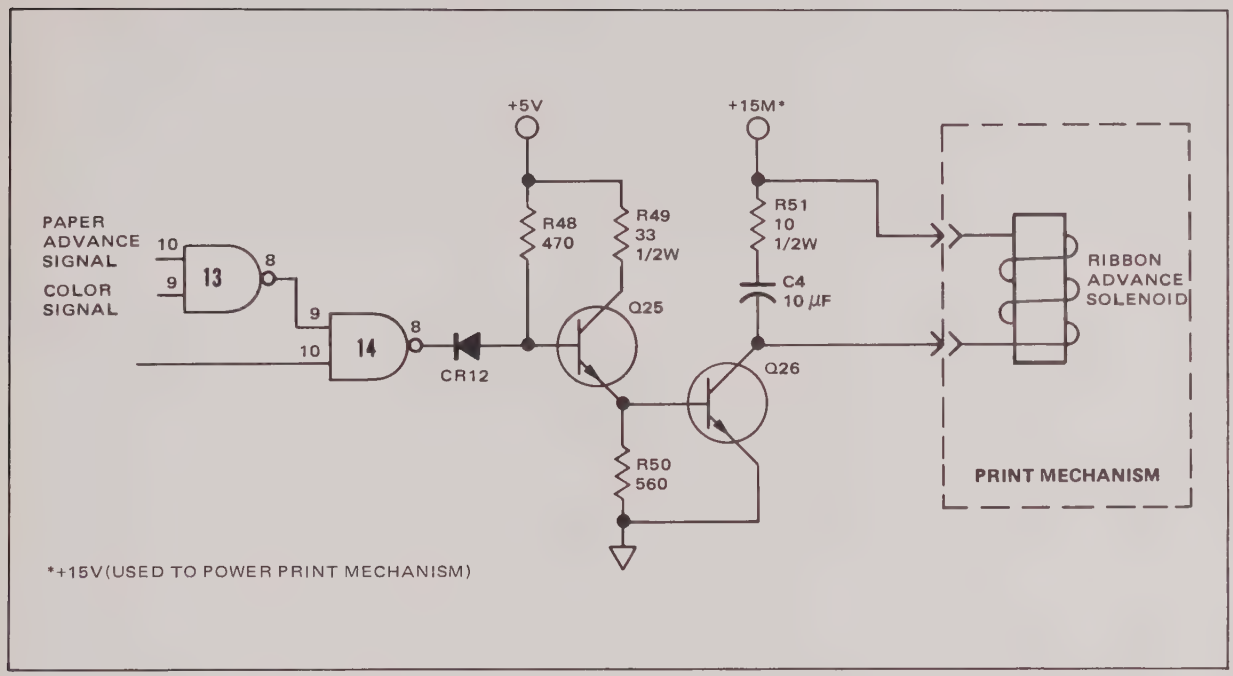


Figure 23. Ribbon Advance Driver Circuit

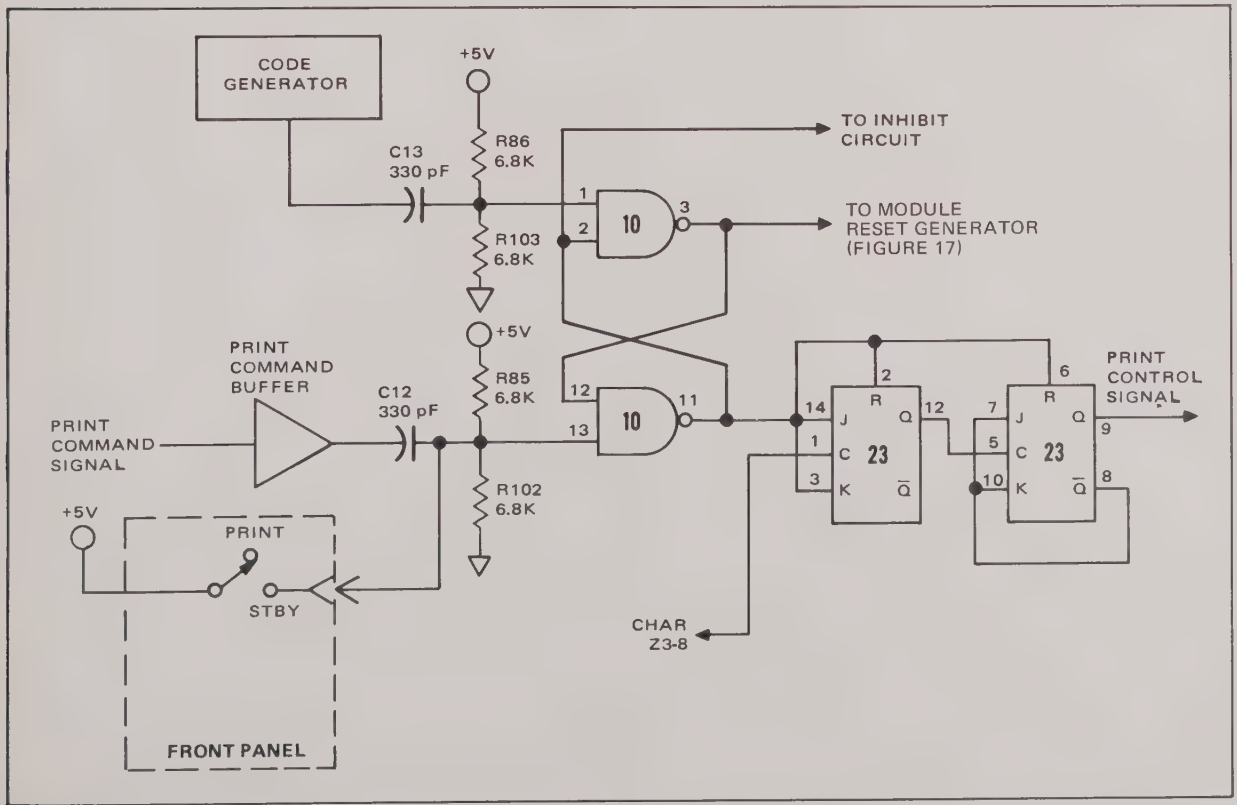


Figure 24. Print Control Circuit

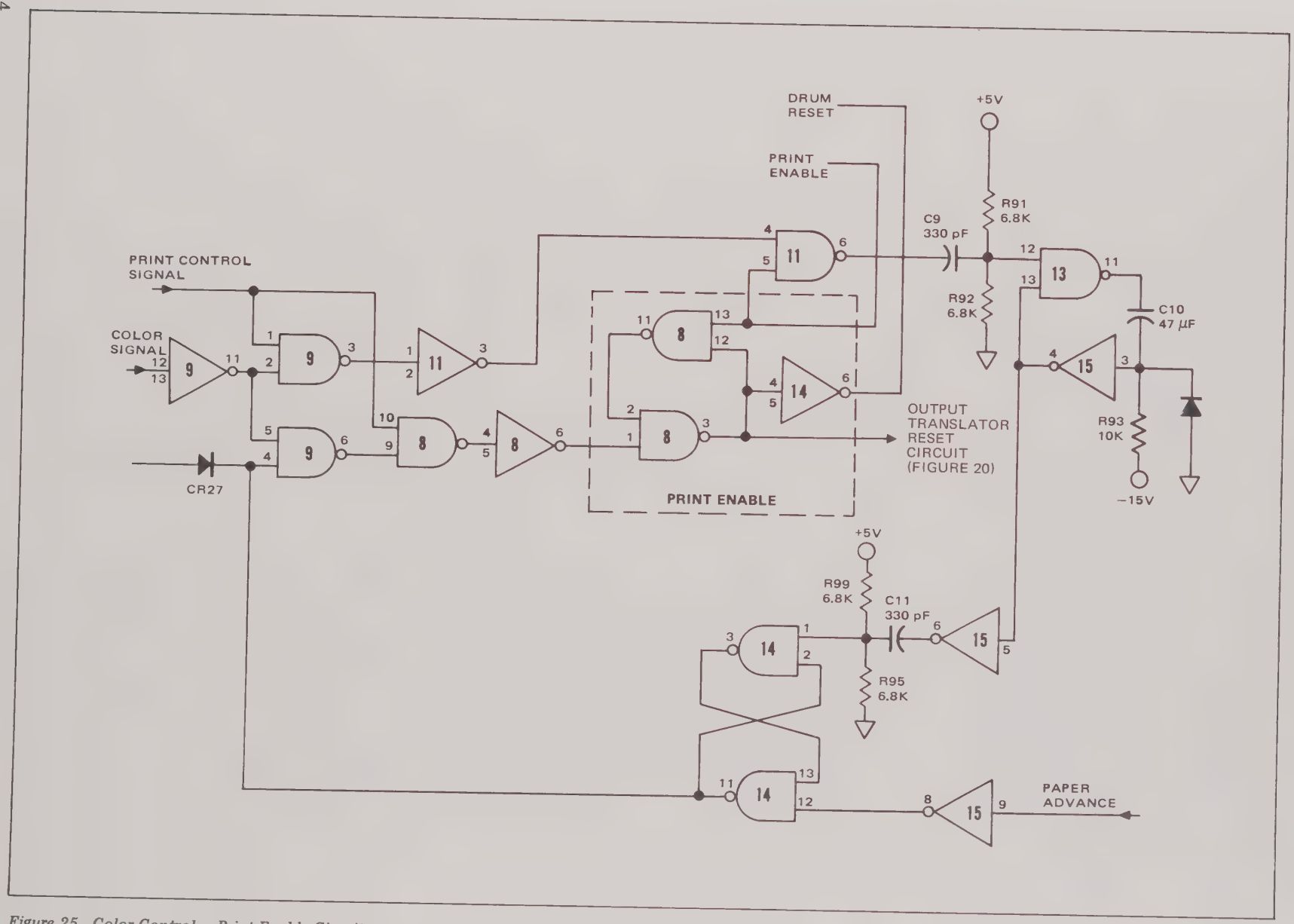


Figure 25. Color Control — Print Enable Circuit

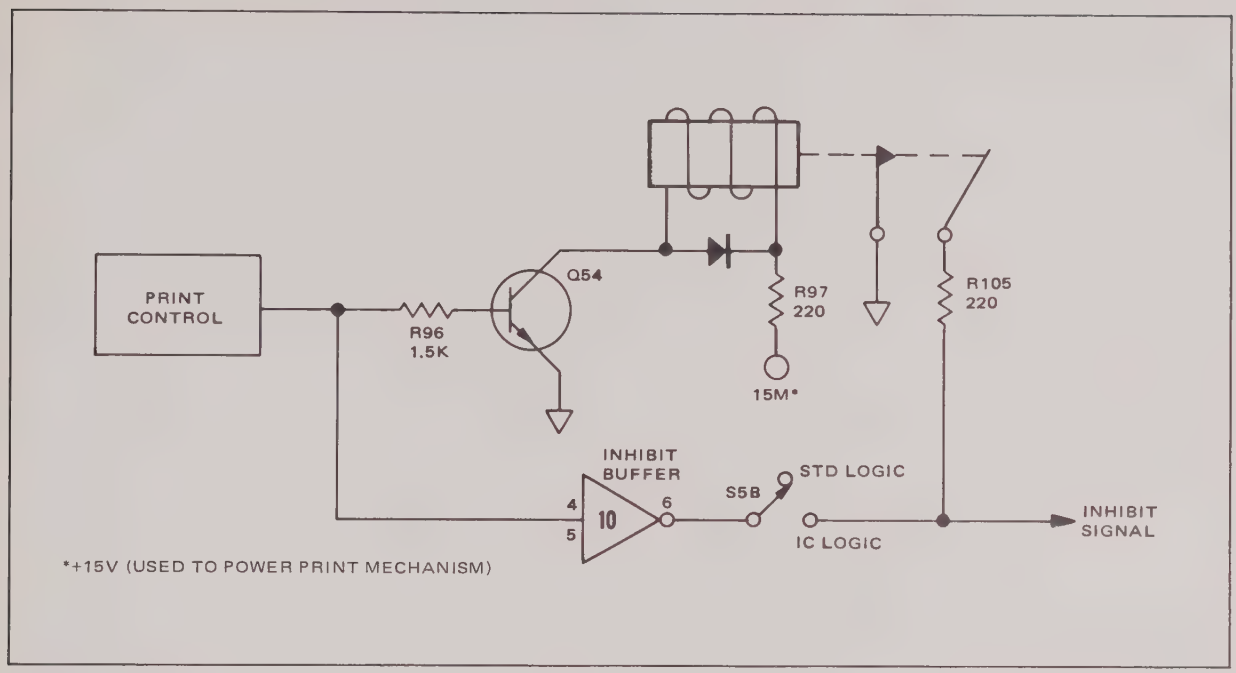


Figure 26. Inhibit Circuit

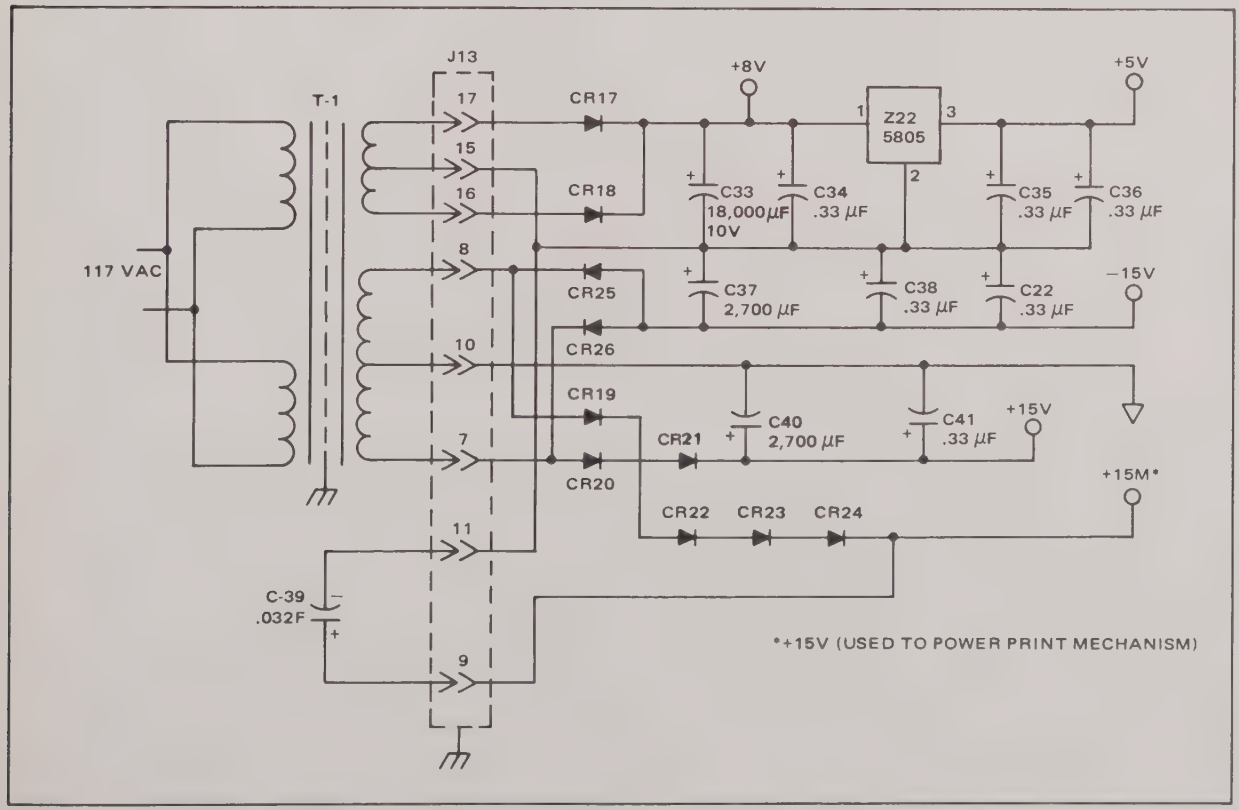


Figure 27. Power Supply Circuit

4.1 GENERAL

This section contains maintenance procedures necessary to sustain operation of the digital printer. The information includes preventive maintenance, adjustment, and troubleshooting. Preventive maintenance encompasses the periodic cleaning and visual inspection necessary to detect physical defects. Troubleshooting involves basic troubleshooting procedures that enable the technician to correct equipment malfunctions.

4.2 PREVENTIVE MAINTENANCE

Preventive maintenance is work performed on the equipment, usually when the equipment is not in use, to keep it in good working order so breakdowns and needless interruptions are minimized.

4.2.1 Cleaning

Proper cleaning of the equipment aids in minimizing breakdowns or malfunctions. The following cleaning methods may be used as applicable.

1. A clean, dry, lint-free cloth; a dry brush; or a vacuum cleaner may be used to remove loose dust, dirt, and lint.

2. If available, dry compressed air at a line pressure not exceeding 30 psi may be used to remove dust from hard to get to places, provided that care is exercised to prevent transfer of dirt to nearby parts. Care must also be exercised to ensure that damage to components or injury to personnel from blown particles does not result from the air blast.

3. Corrosion should be removed with fine crocus cloth (No. 000). Emery paper or steel wool must *never* be used to clean near electrical equipment; the particles that come from such material are conductive and can create short circuits. All dust and metallic particles should be removed by compressed air or vacuum cleaning. If compressed air is used, prevent the scattering of particles to magnetic parts.

4. After corrosion is removed, the affected surface should be treated with paint and/or moisture and fungus resistant Krylon.*

5. Pure ethyl alcohol may be used to clean connector contacts and to remove excess rosin flux; it must not be used, however, to clean insulating varnish.

A registered trademark of the Borden Chemical Co.

CAUTION

When cleaning connector contacts do not get ethyl alcohol on printer mechanism as it removes lubricants and causes extraordinary wear to moving mechanical parts.

4.2.2 VISUAL INSPECTION

Before operating printer, carefully inspect the following:

1. Check the fuse (Figure 5) either visually or with an ohmmeter (1.5 ampere).

2. Check all components for damaged leads and loose connections.

3. Check to see that switches have not been inadvertently placed at the wrong settings.

4. Examine printed circuit boards and components for signs of overheating.

5. Ensure that there is adequate air circulation for the instrument.

NOTE

Before attempting to isolate a printer malfunction remove all system interface connections.

4.2.3 PRINTER MECHANISM SERVICING

The printer mechanism does not require periodic overhaul. By adhering to the instructions described in this paragraph, the printer will maintain its initial fine performance for many years.

4.2.3.1 Cleaning. Clean the printer mechanism with a brush to remove paper chips and dust after each 3 months of operation. The type faces of the print drum should be completely cleaned with a hard-bristle brush or a needle point to maintain clearly printed and well defined numbers and symbols. Use alcohol and benzine to clean the printer.

CAUTION

Do not use mineral solvents (thinner), trichlorethlene, ketone, etc., as these solvents may damage the motor cover, gear cover, and paper cutter.

4.2.3.2 Ribbon Replacement. The print ribbon should be replaced after 6 months of use. When using only a black inked ribbon, service life of the ribbon is doubled.

4.3 BASIC TROUBLESHOOTING

Although this is not a complex electronic instrument, a thorough understanding of the functions of the logic circuits and print mechanism is necessary (Section Three, Functional Description) before attempting to correct any difficulty.

With an understanding of the circuits, a technician should be able to make a reasonable assumption as to the general source of trouble based on the symptoms. Repairs when needed are simplified by the use of IC (integrated circuits). Faulty IC components are easy to remove and replace (Paragraph 4.5).

Frequently, a visual inspection and a systematic approach to the troubleshooting problem may be more rewarding than a haphazard check of voltages and waveforms. The following instructions are presented as an aid in formulating the systematic approach.

In troubleshooting electronic equipment, sources of problems can be divided into two categories:

1. Improper operating procedures.

2. Equipment malfunctions.

The first category, with human error, is a more prevalent source of equipment problems than most people care to admit. Therefore, this category should always be investigated and eliminated before it is assumed that a valid equipment malfunction exists. After eliminating all possibility of human error, an equipment malfunction can, with assurance, be systematically approached. It is vitally important to define the problem before attempting to solve it. The basic procedure consists of the following steps:

1. *Examine Evidence of Trouble.* Study the problem thoroughly. For example, if the printer readout indicates erroneous information, note whether the trouble is in all printed columns or whether the error applies to an individual printed column. Examine the data reaching the printer; it should be in agreement with the data on the print storage register. Gather clues from all accessible check points.

   a. Print readout

   b. Circuit Board test points

   c. Printed records from external sources (when available).

   In evaluating indications from the various check-points, determine particularly whether a disagreement exists between various related functions.

2. *Look for Obvious Solutions First.* Question the coincidence of failure with other recent events, such as cleaning or servicing. Human errors sometimes result in accidentally displaced control settings. Quite often the solution to a difficulty will become self-evident through thoughtful analysis of immediate indications.

3. *Isolate Problem to a Major Functional Area.* Although the equipment is an integrated network of functional activities, for troubleshooting purposes it is convenient to subdivide it into its major functional circuits. (Refer to Functional Block Diagram, Figure 10, for location). To locate various components, see the individual assembly drawings in Section 5.

   As you develop a working knowledge of the overall equipment, you will experience little difficulty with this isolation step. Isolating the disorder to an individual functional circuit can be accomplished either by a method of direct association or through a process of elimination.

4. *Analyze Reduced Problem Area for Final Solution.* When the investigation has been narrowed down to a restricted circuit area, the rest of the unit can be temporarily ignored.

5. *Correct the Difficulty.* When the final solution has been reached, and the defective or faulty part has been pinpointed, remedy the fault by replacing the component as required. Some remedies, however, may call for performing a repair on one of the relatively few

assemblies that is not designated for instant removal and replacement. Typical of these items is a break in the circuit board etching.

6. *Restore Conditions for Normal Operation.* When all remedies have been completed, make sure that the unit is returned to normal operating condition. If controls have been changed to facilitate troubleshooting, reset them. Note particularly that all circuit board components are in and secured, and all switches are set properly.

4.4 SPECIFIC TROUBLESHOOTING

The Beckman Model 1453B Digital Printer uses integrated circuit components for operation. Before attempting to service this instrument, observe the following special precautions when troubleshooting and servicing integrated circuits.

1. *Be sure that the ground terminals or chassis of all the line-operated test equipment are solidly and securely connected to instrument ground.*
2. *Use small pin-tipped test probes on meters and oscilloscopes to reduce the chance of shorting IC leads together.*
3. *The power supplies can be damaged; therefore, the greatest care must be used to avoid even a momentary short at any point in a circuit to ground or to other circuit points.*
4. *Do not allow "dangling" oscilloscope probe ground leads, or other stray leads, to touch circuitry in the instrument.*
5. *Unplug the line cord before removing or replacing components.*

Before attempting to service the integrated circuits used in this digital printer refer to Paragraph 4.5.

4.4.1 Repair

When a trouble is traced to a defective individual part, replacement should be made with identical parts, if practical. Refer to the drawings in Section 5 for correct values, tolerances, etc. When substitutions are necessary, use components that duplicate the originals in every possible respect.

CAUTION

Avoid applying excessive heat to the printed circuit board by using a small iron and working quickly.

4.4.2 Initial Visual Inspection

If the printer fails to print properly and trouble is suspected, then start the troubleshooting procedure with the following complete visual inspection.

1. Check all front panel controls to see if they are in their proper positions for normal print condition.
2. Check all cable and connector inputs including power to see that all cables are still properly and securely connected.
3. Check the paper threading and print ribbon to see that they are correct and normal for proper operation.
4. Check the fuse on the rear panel.

4.4.3 Trouble Symptom

If the complete visual inspection does not reveal a source of trouble, the next step is to analyze the instrument further by making an actual printout.

Place the printer in a normal operating mode and determine what functions are performing properly and note all malfunctioning areas. An example of a malfunctioning indication is that all columns print data properly except one, and this column does not print data.

After determining and defining the symptoms, refer to Section Three, Functional Description,and read the sections that describe the functional area in which the trouble appears to be occurring.

4.4.4 Substitution

If the trouble appears to be on an input code module or in a certain section of the print mechanism, the input code modules should be removed or moved to a new position. This is useful in identifying the location of the problem.

All integrated circuit components are mounted in sockets and suspected faulty components can be carefully removed and switched with identical components to see if the trouble moves to a new area. This is extremely helpful if test equipment is not available for troubleshooting.

4.4.5 Signal Tracing

Signal tracing can be done by using a good dual channel trigger oscilloscope. Timing Diagrams in

Section Three can be used to help locate a faulty circuit. Also Section Three discusses the normal functional operation of all circuits. This section should be consulted before and during troubleshooting.

4.4.6 Printer Troubleshooting Guide

Table 3 lists various symptoms, discusses the possible resultant problems, and the remedy to correct the difficulty.

4.5 SERVICING INTEGRATED CIRCUITS

All integrated circuits are located in sockets. The removal and substitution of identical type integrated circuits is a convenient method of troubleshooting once the problem has been isolated to a particular section of the instrument.

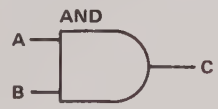
CAUTION

Care must be taken to insert integrated circuits correctly in the socket. Pin 1 of the IC must be inserted in Pin 1 of the socket to prevent permanent damage to the IC.

Use the logic symbols and equations defined in Figure 28 to interpret the logic diagrams and truth tables listed in Table 4.

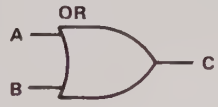
SYMPTOM	POSSIBLE PROBLEM	REMEDY
Printer will not start	Line cord not plugged in	Plug in
	Power fuse blown	Replace
	Faulty +15 unregulated supply	Locate & correct trouble
	Faulty Print Mechanism	Replace defective unit
	Loose Connector to Print Mechanism	Correct Trouble
Printer runs, but will not accept or respond to print command	Defective power supply	Test power supply — replace defective parts
	Defective timing circuit	Test or substitute to determine condition
	Defective print buffer	Test or substitute to determine condition
	Defective color control	Test or substitute to determine condition
	Defective print enable	Test or substitute to determine condition
Some columns print properly, others fail to print properly or print at all	Defective Input Code Module	Substitute module from another position. Repair or replace if defective.
	Defective Code Line to Modules	Test and Repair
	Defective column in print mechanism	Test by moving Input Code Module to another position. Replace defective print mechanism
Printer prints continuously in one column	Defective magnet drive transistor (Shorted)	Test condition, replace if defective
	Defective column in print mechanism	Test by removing Input Code Module. If print mechanism is faulty, it will continue to print without an input board.
		Replace defective print mechanism
Printer does not give proper advance (Test by paper advance pushbutton)	Paper jammed	Check and clear
	Defective paper advance	Test on logic board. Replace defective ocmponent
	Defective print mechanism	Replace defective print mechanism
No ribbon advance or will not print red	Defective ribbon advance drive Q6	Test on logic board. Replace defective component
	Defective print mechanism	Replace defective print mechanism

Table 3. Printer Troubleshooting Guide



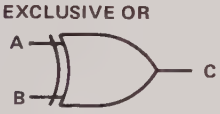
A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

$A \cdot B = C$



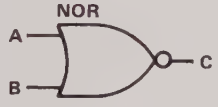
A	B	C
0	0	0
0	1	1
1	0	1
1	1	1

$A+B = C$



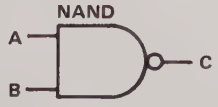
A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

$A \cdot \overline{B} + B \cdot \overline{A} = C$



A	B	C
0	0	1
0	1	0
1	0	0
1	1	0

$A+B = \overline{C}$



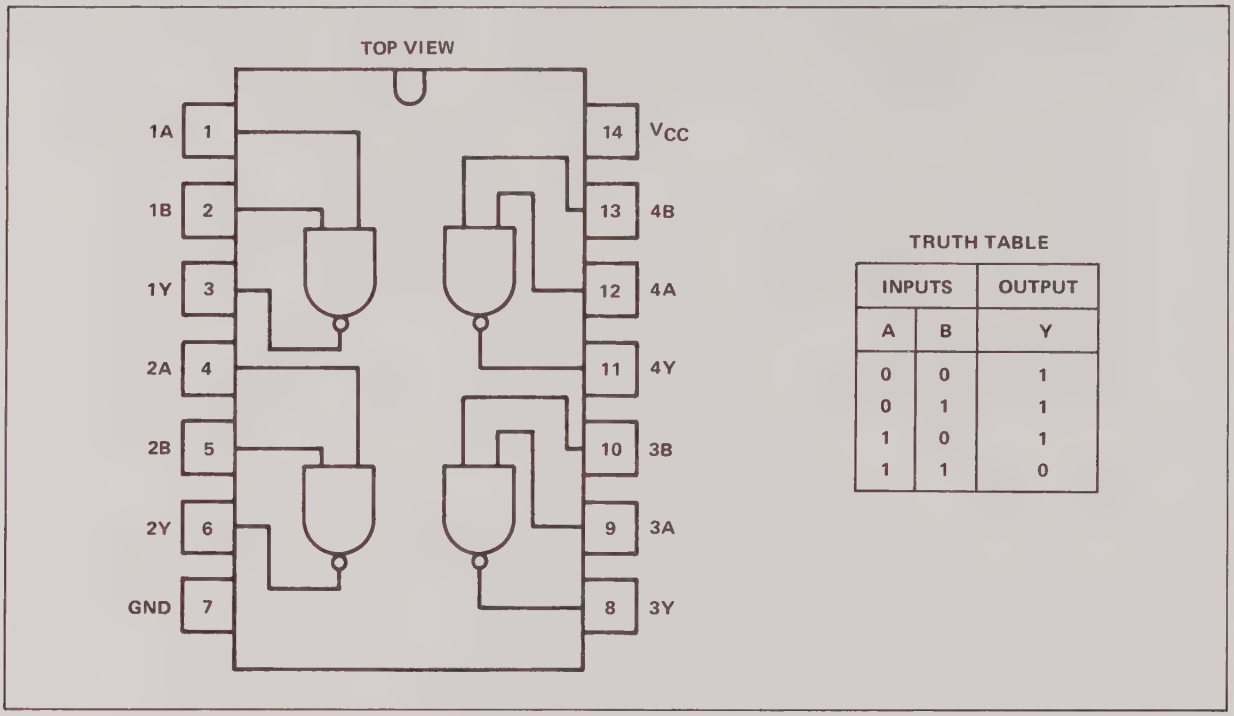
A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

$A \cdot B = \overline{C}$

Figure 28. Logic Symbols and Truth Tables

TYPE	NUMBER	DESCRIPTION	FIGURE NUMBER	BECKMAN PART NUMBER
TTL	SN7400N	Quad Two-Input NAND Gate	29	885-846972
DTL	MC846P	Quad Two-Input NAND Gate	29	885-846627
TTL	SN7404N	Hex Inverter	30	885-857666
DTL	MC837P	Hex Inverter	30	885-846628
DTL	MC830P	Dual Four-Input NAND Gate	31	885-846631
TTL	SN7473N	Dual J-K Master-Slave Flip Flop	32	885-863952

Table 4. Integrated Circuit Logic Diagrams and Truth Tables



TRUTH TABLE

INPUTS		OUTPUT
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

Figure 29. Quad Two-Input NAND Gate, IC Diagram, and Truth Table

TRUTH TABLE

INPUT	OUTPUT
1	0
0	1

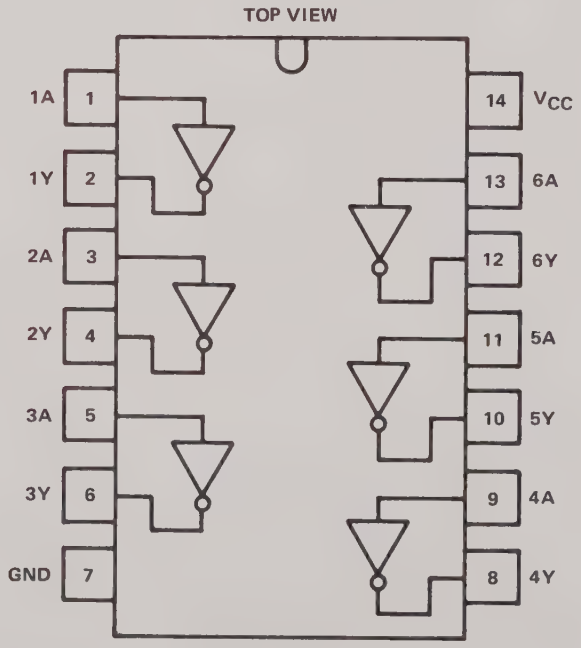
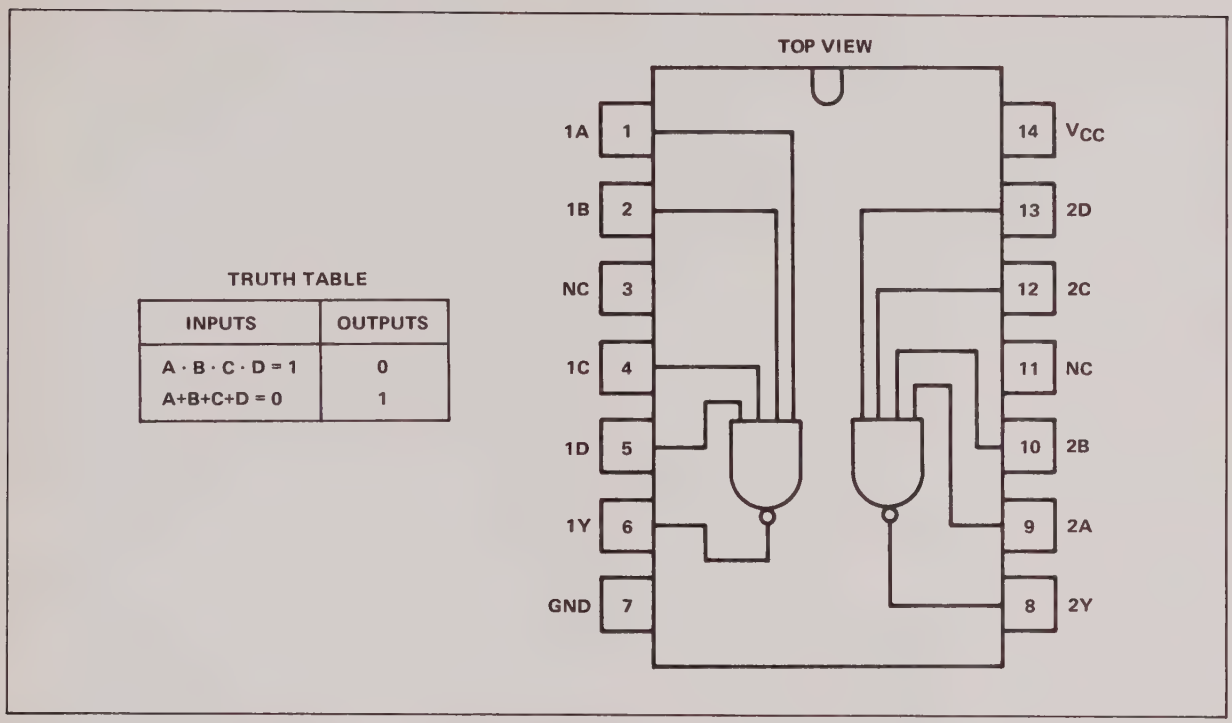


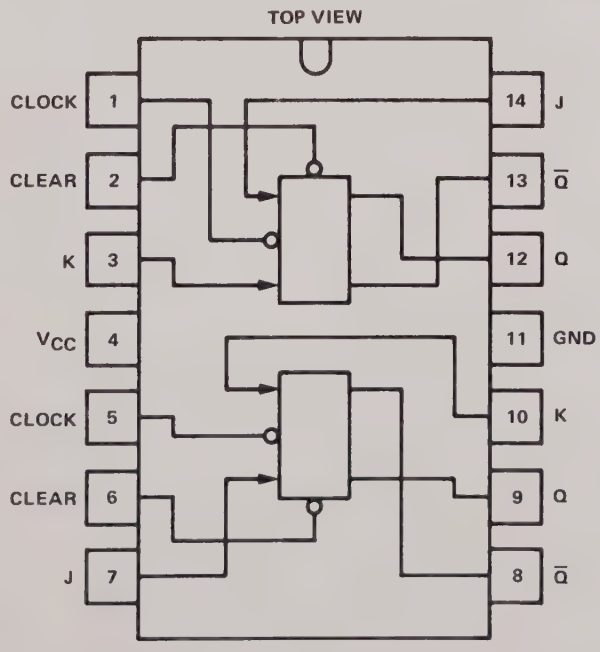
Figure 30. Hex Inverter, IC Diagram, and Truth Table



TRUTH TABLE

INPUTS	OUTPUTS
A · B · C · D = 1	0
A+B+C+D = 0	1

Figure 31. Dual Four-Input NAND Gate, IC Diagram, and Truth Table



TRUTH TABLE

t_n		t_{n+1}
J	K	Q
0	0	Q_n
0	1	0
1	0	1
1	1	$\overline{Q}_n$

Figure 32. Dual J-K Master-Slave Flip Flop, IC Diagram, and Truth Table

This section includes the complete parts list, configuration drawings, diagrams, circuit board component layouts, and schematic diagrams for the Beckman Model 1453B Digital Printer.

Assembly Drawings of the Model 1453B Digital Printer are included in the following illustrations:

Figure	Title	Page
33	Model 1453B Digital Printer (Basic) Wired and Mechanical Assembly	
34	Enclosure Assembly	
35	Front Panel Assembly	
36	Bracket and Harness Assembly	
37	Master Circuit Board Assembly (2 sheets)	
39	Four-Line Input Module Assembly	
41	Ten-Line Input Module Assembly "A"	
42	Ten-Line Input Module Assembly "B"	
44	IC Input Module Circuit Board Assembly	
45	IC Input Module Top Assembly	
50	Ten-Line Input Cable Assembly	

Schematic and wiring diagrams of the 1453B Digital Printer are included in the following illustrations.

Figure	Title	Page
38	1453B Digital Printer, Schematic Diagram	
40	Four-Line Input Module, Schematic Diagram	
43	Ten-Line Input Module, Schematic Diagram	
46	IC Input Module, Schematic Diagram	
47	Four-Line Input Cable, Schematic Diagram	
48	Four-Line Input Cable (8 Column), Schematic Diagram	
49	Four-Line Input Cable (For 6401 Counter), Schematic Diagram	
50	Ten-Line Input Cable, Wiring Diagram	

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
1		855-437847	Enclosure Assembly, Mechanical and Wired (See Figure 34)		1
2		405-404184	Pin, Guide		1
5		449-437808	Digital Printer & Chassis Assembly		1
6		855-437805	Front Panel Assembly (See Figure 36)		1
7		855-437848	Bracket (See Figure 37)		1
8	C39	631-866633	Capacitor, 32000 μF, 25V −10 +75%		1
9		855-437851	Master Circuit Board Assembly (See Figure 38)		1
10		349-437618	Roll Cradle Assembly		1
11		223-437617	Shaft, Roll, Stainless Steel		1

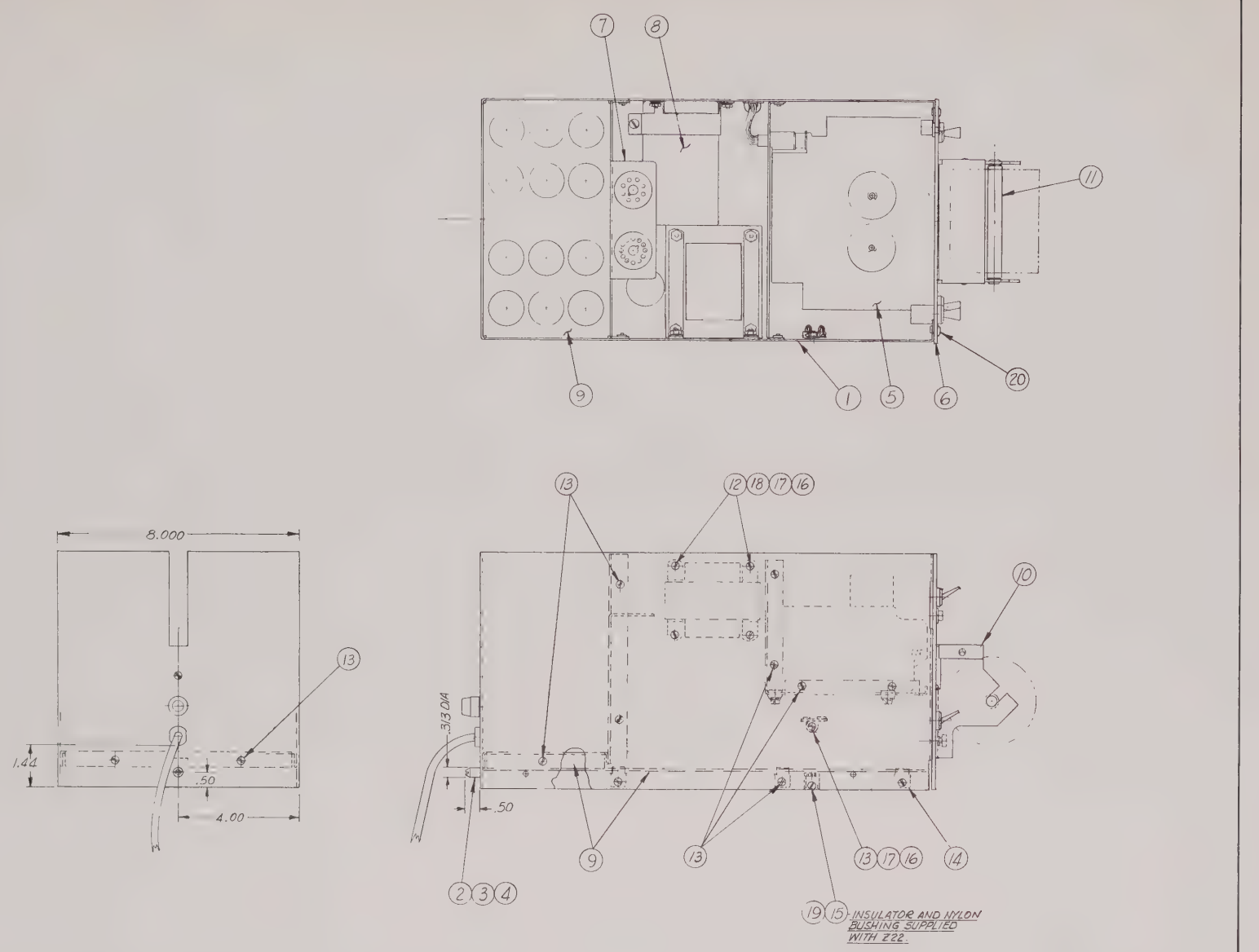


Figure 33. Model 1453B Digital Printer (Basic) Wired and Mechanical Assembly (855-437850, Rev A)

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
			INPUT MODULES		
		887-404459	Four-Line Module Assembly (See Figure 40 and 41)		
		887-404453	Ten-Line Module Assembly (See Figures 42, 43 and 44)		
		887-525726	IC Input Module Assembly (See Figures 45, 46, and 47)		
			CABLE ASSEMBLIES		
		664-404567	Four-Line Input Cable Assembly (See Figure 48)		
		664-436034	Four-Line Input Cable (8 Col) Assembly (See Figure 49)		
		664-437166	Four-Line Input Cable (Model 6401) Assembly (See Figure 50)		
		664-405888	Ten-Line Input Cable Assembly (See Figure 51)		

ENCLOSURE ASSEMBLY PARTS LIST (855-437847, Rev. A)

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
1		293-437810	Enclosure Assembly		1
5		338-841637	Clamp, Capacitor MAL#VR-10		1
6		735-007268	Fuse Holder, Non-Ind		1
7		731-801567	Fuse, 1-1/2A SLO-BLO, 3AG		1
10		664-812450	Line Cord		1
11		338-064387	Clamp, Cable HM#SR-5P-1		1
12		687-835163	Lug, Ring, 6:18-22GA		1

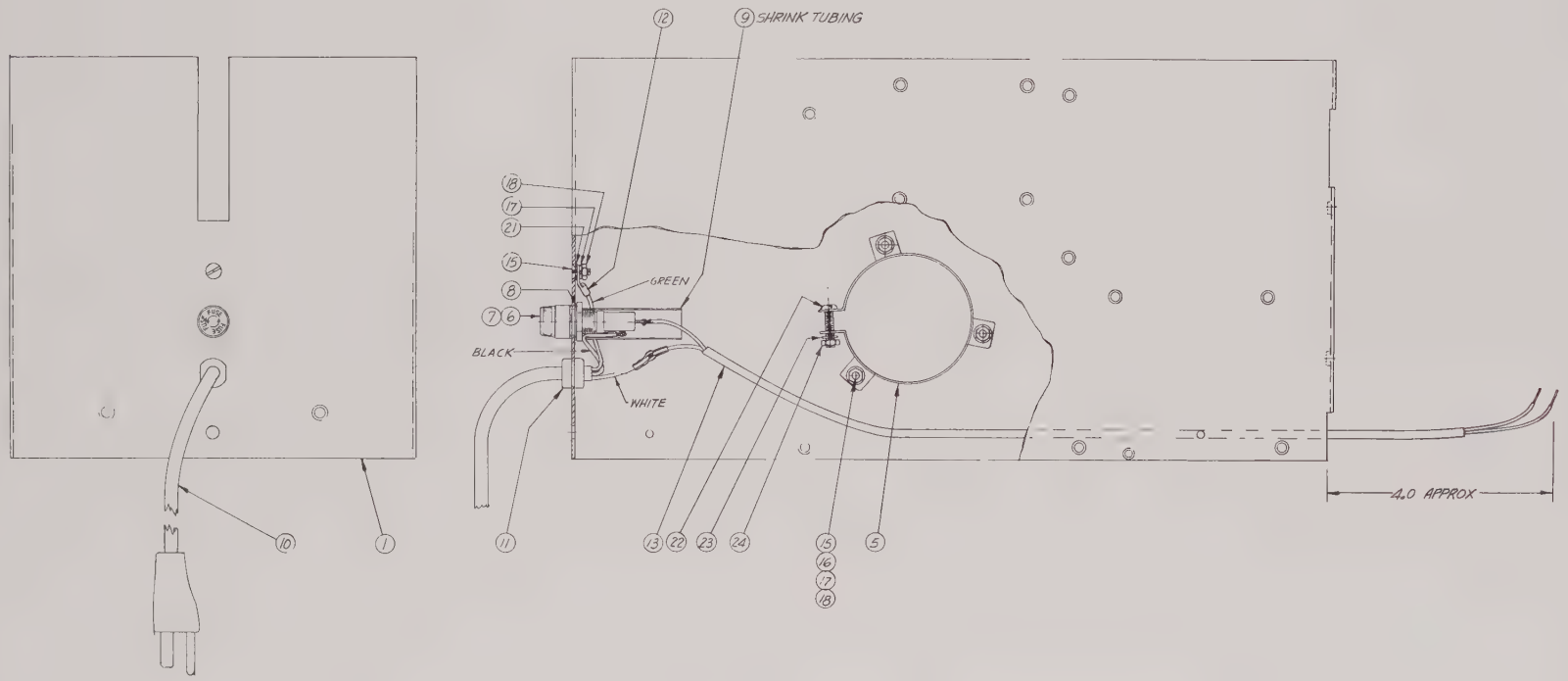


Figure 34. Enclosure Assembly Parts List (855-437847)

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
1		433-437804	Panel Assembly, Front		1
2		101-803007	Screw, Thumb, 6- 32 x 3/8		1
3	S 2, 3	701-853832	Switch, SPST, Toggle	Cutler-Hammer 8381K27C	2
4	S 4	701-869289	Switch, SPST, Toggle		1
5	S 1	704-813496	Pushbutton SPDT	Switchcraft 913	1
6		338-835572	Cable Clamp, Strap		REF

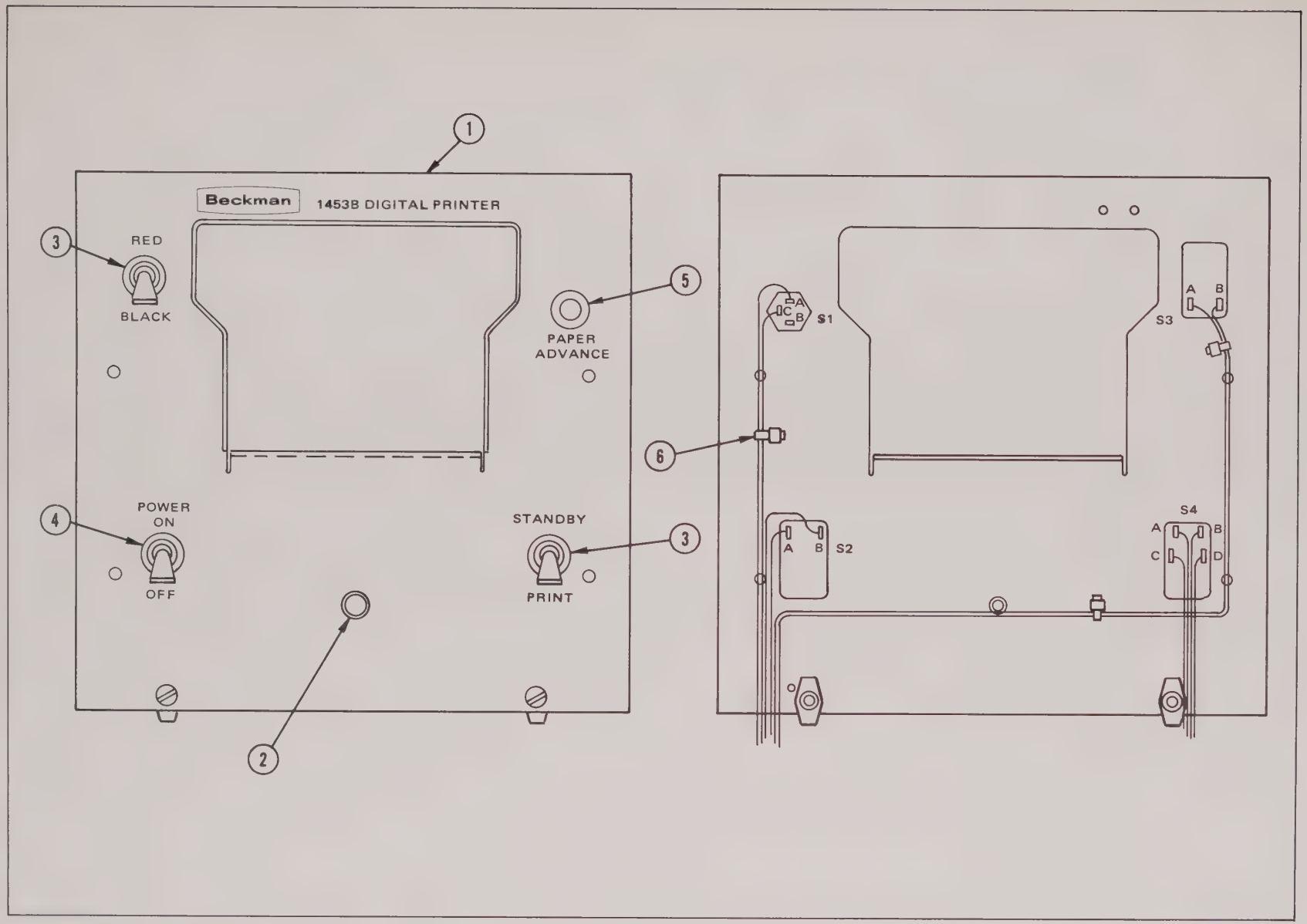


Figure 35. Front Panel Assembly

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
1		327-437812	Bracket Assembly, Module		1
2	P105	678-806893	8 Pin Header		1
3	P104	678-815041	11 Pin Header		1
4		662-437856	Cable Harness Assembly		1
[1]	P13	680-828261	• P.C. Connector, 22 Contacts		1
[3]	T1	792-437401	• Power Transformer		1
[4]		691-000506	• Barrier Strip		1

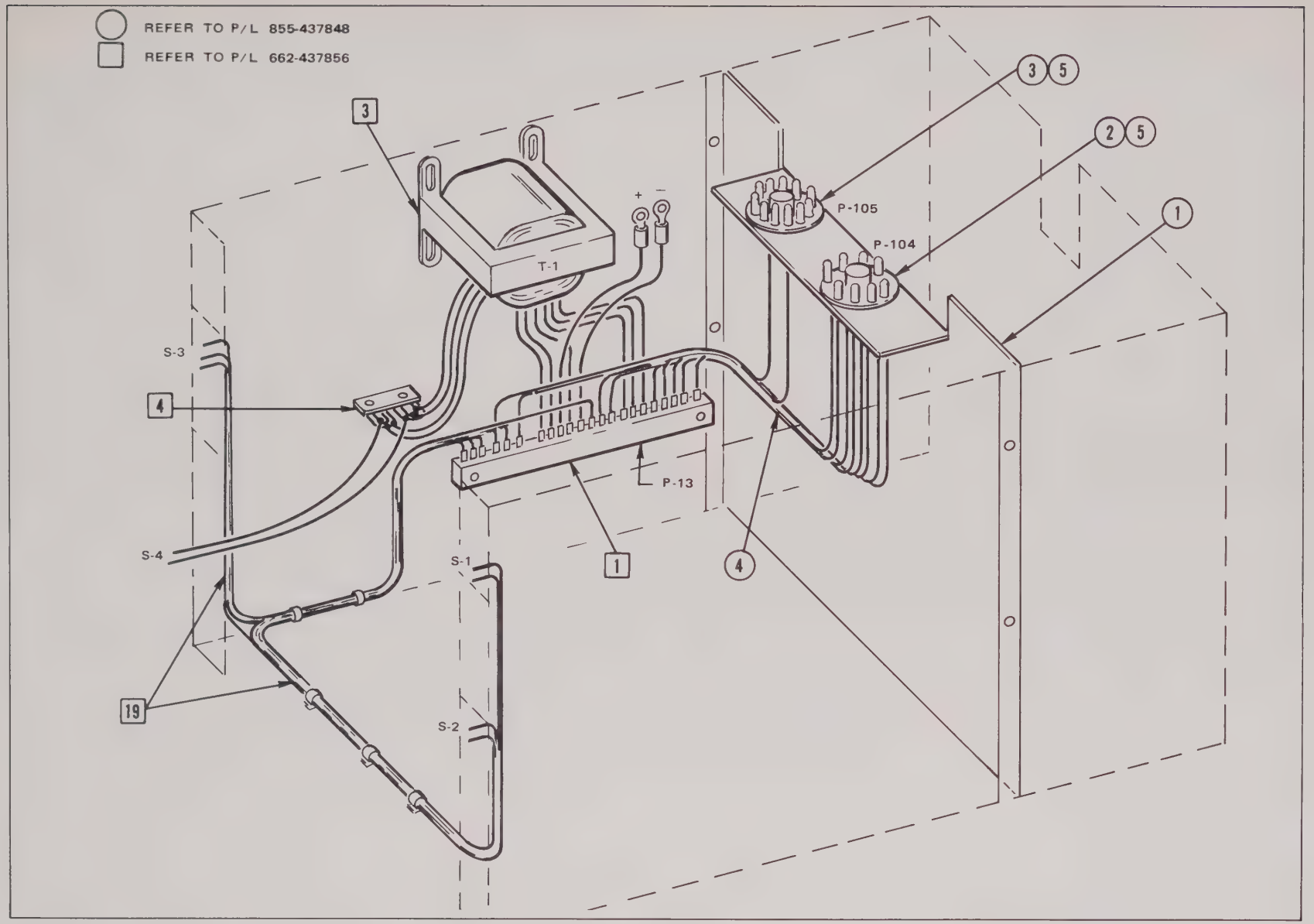
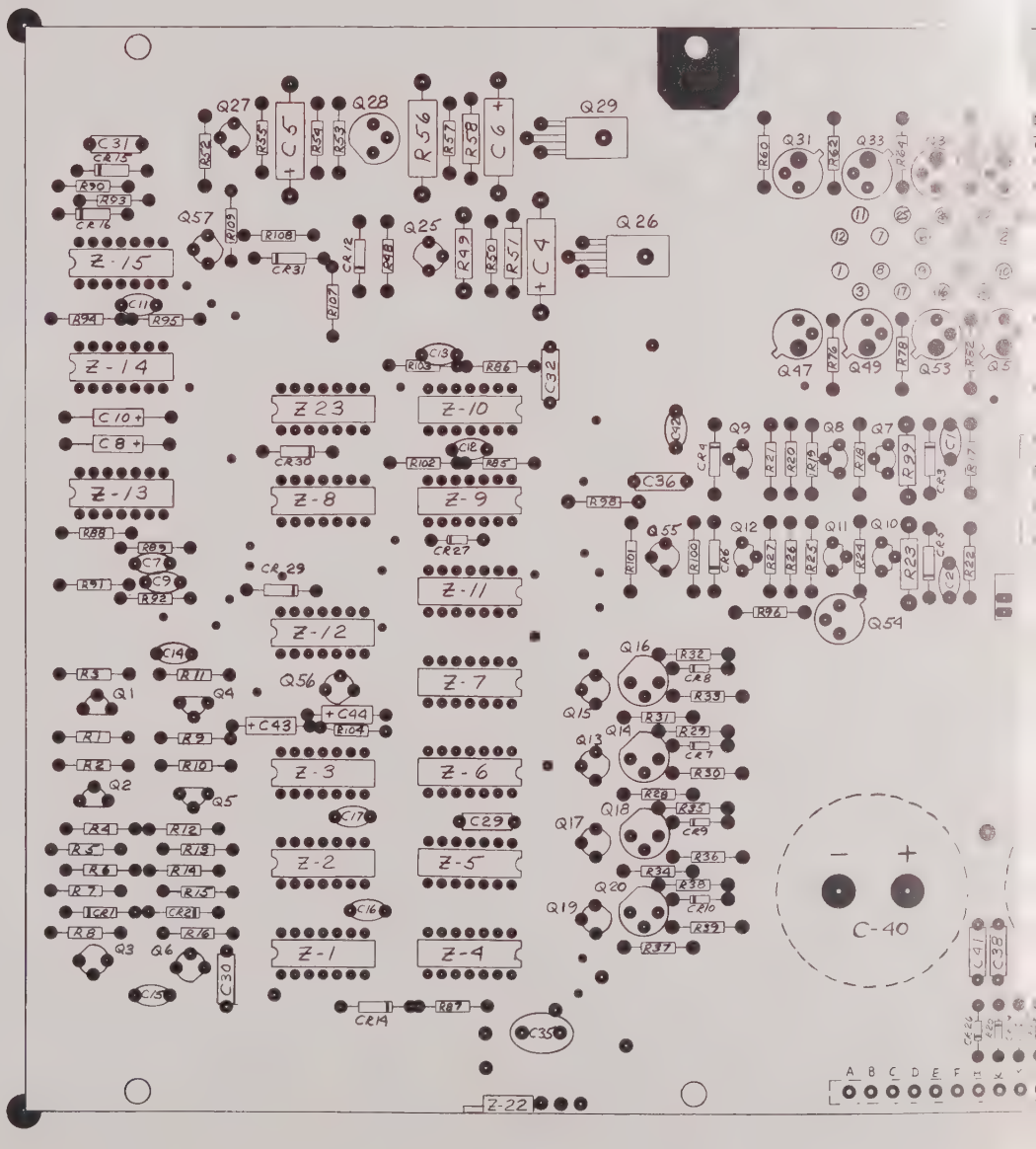


Figure 36. Bracket and Harness Assembly (855-437848, Rev A)

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
		693-437841	Printed Circuit Board	Beckman	1
	C1, 2, 14	637-822757	Capacitor, Mica, 1000pF, 100V	Sangamo D1510 F102J0	3
	C3	633-804722	Capacitor, Cerm 0.02 μF, 500V GMV	Aerovox BCD-DI-6Z5U-203Z	1
	C4, 6	631-802891	Capacitor, Elect., 10 μF, 25V, −10 +75%	Sprague 30D182A1	2
	C5	631-835662	Capacitor, Tant., 6.8 μF, 35V	Fansteel STA-68S-1	1
	C7, 9, 11, 12, 13	637-822908	Capacitor, Mica, 330 pF, 500V, 5%	Electromot DM15F3315D-500WV4CR	5
	C8, 10, 46	631-835774	Capacitor, Tant, 47 μF, 6V, 10%	Compine TS2-006476-10	3
	C15, 16, 17	633-836864	Capacitor, Cerm., 0.01 μF, 100V, 20%	Sprague C023B101F103M	3
	C18 thru 32, 34, 36, 38, 41	633-815873	Capacitor, 0.33 μF, Cerm, 25V, +80 −20%	Sprague 5C023334D8250B3	19
	C33	631-846284	Capacitor, Elect., 18,000 μF, 10V, −10 +75%	Sprague 36D183G010AC2A	1
	C35	631-857569	Capacitor, Elect., 33 μF, 25V	Sprague 196D336X0015FB	1
	C37, 40	631-857304	Capacitor, Elect., 2,700 μF, 25V	Sprague 36D272G025AA2B	2
	C42	637-822251	Capacitor, 100 pF		1
	C43, 45	631-802979	Capacitor, 22 μF		2
	C44	631-814053	Capacitor, 1 μF		1
	CR1-12, 14-16, 28-31	755-838731	Diode, Silicon	Contdev 1N4448	19
	CR13	755-828977	Diode, Zener	Motorola 1N758A	1
	CR17, 18	755-857551	Rectifier	Semtech 1N5198	2
	CR19-26	755-416842	Rectifier, Special	Beckman	8
	CR27	755-420893	Diode, Special	Beckman	1
	CR28	755-838731	Diode 1N4448		1
	XA-101-112	860-857739	Socket, 11 Pin	Amphenol No. 78-SIIW-0125	12
	J13	680-857737	Connector, 22 Pin	Amphenol, No. 143-022-07	1
	K1	718-857595	Relay, 12V, SPST	Jenco, RR10-01-12	1
	Q1, 2, 4, 5, 9, 12	755-852629	Transistor, PNP	Texas Instruments, 2N4062	6
	Q3, 6, 13, 15, 17, 18, 23, 25, 26, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 55, 56, 57,	755-838784	Transistor, NPN	Fairchild, 2N3565	24
	Q7, 8, 10, 11	755-857485	Transistor, FET, Silicon	Texas Instruments, T1S58G	4

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
	Q14, 16, 18, 20 21, 24, 28	755-839888	Transistor	Fairchild, 2N3638A	7
	Q22, 31, 33, 35, 37, 39, 41, 43, 46, 47, 49, 51, 53, 54	755-817964	Transistor, NPN	Any 2N1420	14
	Q26, 29	755-862085	Transistor	Any 2N5190	1
	R1, 9, 107	601-822328	Resistor, 2.2K, 1/4W, 5%	Allen Bradley, CB2225	3
	R2, 10	601-823388	Resistor, 56 ohm, 1/4W, 5%	Allen Bradley, CB5605	2
	R3, 11, 42, 82, 84-88, 89, 91, 92, 94, 95, 98, 102, 103	601-822299	Resistor, 6.8K, 1/4W, 5%	Allen Bradley, CB6825	17
	R4, 12, 52, 106	601-822308	Resistor, 1K, 1/4W, 5%	Allen Bradley, CB1035	4
	R5, 13	601-822297	Resistor, 4.7K, 1/4W, 5%	Allen Bradley, CB4725	2
	R6, 14, 44, 83	601-823393	Resistor, 270 ohm, 1/4W, 5%	Allen Bradley, CB2715	4
	R7, 15, 90, 93, 108, 109	601-822324	Resistor, 10K, 1/4W, 5%	Allen Bradley, CB1035	6
	R8, 16	601-822296	Resistor, 3.3K, 1/4W, 5%	Allen Bradley, CB3325	2
	R17, 22	601-823916	Resistor, 1M, 1/4W, 5%	Allen Bradley, CB1065	2
	R18, 24	601-823397	Resistor, 5.6K, 1/4W, 5%	Allen Bradley, CB5625	2
	R19, 25, 27, 28, 29, 31, 32, 34, 35, 37, 38, 41, 43, 50, 53, 57, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82	601-823396	Resistor, 560 ohm, 1/4W, 5%	Allen Bradley, CB5615	28
	R20, 26, 30, 33, 36, 39, 45, 96	601-822527	Resistor, 1.5K, 1/4W, 5%	Allen Bradley, CB1525	8
	R21, 104	601-822326	Resistor, 1.2K, 1/4W, 5%	Allen Bradley, CB1225	2
	R23, 99	601-011180	Resistor, 10M, 1/2W, 10%	Allen Bradley, EB1061	2
	R46, 47	601-801803	Resistor, 12K, 1/4W, 5%	Allen Bradley, CB1235	2
	R48, 27	601-823395	Resistor, 470 ohm, 1/4W, 5%	Allen Bradley, CB4715	2
	R49	601-800007	Resistor, 33 ohm, 1/2W, 5%	Allen Bradley, EB3305	1
	R51, 58	601-022946	Resistor, 10 ohm, 1/2W, 5%	Allen Bradley, EB1005	2
	R54, 59, 61, 63, 65, 67, 69, 71, 73, 75, 77, 79, 81	601-822295	Resistor, 2.7K, 1/4W, 5%	Allen Bradley, CB2725	13

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
	R55	601-817735	Resistor, 100 ohm, 1/4W, 5%	Allen Bradley, CB1015	1
	R56	601-001395	Resistor, 100 ohm, 1W, 5%	Allen Bradley, GB1015	1
	R97, 105	601-822327	Resistor, 220 ohm, 1/4W, 5%	Allen Bradley, CB2215	2
	R40, 110	601-823394	Resistor, 330 ohm, 1/4W, 5%	Allen Bradley, CB3315	2
	S5, 6	716-852680	Switch, DPDT, P.C. Slide	Cont. Wirt. G126	2
	XZ1-XZ21, 23	860-857545	I.C. Socket, 14 Pin	Cinch 133-51-02-003	22
	Z1 (or SN15837)	885-846628	Integrated Circuit	Motorola MC837P	1
	Z2, 6, 7, 16-21, 23	885-863952	Integrated Circuit	Texas Instrument SN7473N	10
	Z3, 5, 11	885-846627	Integrated Circuit	Motorola MC846P (or SN15846N)	3
	Z4	885-846631	Integrated Circuit	Motorola MC830P or (SN15830N)	1
	Z8, 9, 10, 12, 13, 14	885-846972	Integrated Circuit	Texas Instruments (SN7400N)	6
	Z15	885-857634	Integrated Circuit	Texas Instruments (SN7404M)	1
	Z22	885-871987	Integrated Circuit	Fairchild or Motorola UGH 7805393	1
		121-852899	Rivet, Blind, 1/8 Diameter		24
		662-437855	Harness Assembly, Cable		1
	P14	672-824765	• Connector, 36 Pin		1
		338-835173	• Tie Wrap, Tie Down		1
		430-437814	Chassis, Assembly, Module		1
	C42	637-822251	Capacitor, Mica 100 pF		1
	C43	631-802979	Capacitor, 22 μF, 15V		1
	C44	631-814053	Capacitor, 1 μF, 35V		1
	CR27	755-420893	Diode, Special		1


Q27
Q28
Q29
C 5 +
R56
C 6 +
C 31
CR15
R90
R93
CR16
Q57
R105
R108
CR31
CR12
R48
R107
Q25
R49
R50
R51
C 4 +
Q 26
Z-15
C11
R94
R95
Z-14
C10+
C8+
Z-13
R88
R89
C7
C9
R97
R92
Z 23
Z-8
C18
R103
R86
C32
C12
R102
R85
Z-10
Z-9
CR27
CR29
Z-12
Z-11
C14
R3
R11
Q1
Q4
Q56
+C43
+C44
R104
Z-7
R1
R9
R2
R10
Q2
Q5
Z-3
Z-6
C17
C29
R4
R12
R5
R13
R6
R14
R7
R15
CR21
CR22
R8
R16
Q3
Q6
C30
C15
Z-2
Z-5
C16
Z-1
Z-4
CR14
R87
C35
Z-22
Q31
Q33
R60
R62
R64
Q47
Q49
Q53
Q5
R76
R78
R82
C36
R98
CR4
Q9
Q8
Q7
R27
R20
R19
R8
R29
C3
C1
R17
Q55
Q12
Q11
Q10
R101
R100
CR6
R27
R26
R23
R24
R23
C4
C2
R22
R96
Q54
Q16
R32
CR8
Q15
R31
R33
Q14
R29
CR7
Q13
R30
R28
Q18
R35
CR9
Q17
R36
R34
R38
Q20
CR10
Q19
R39
R37
C-40
C41
C38
A B C D E F H K
CR24

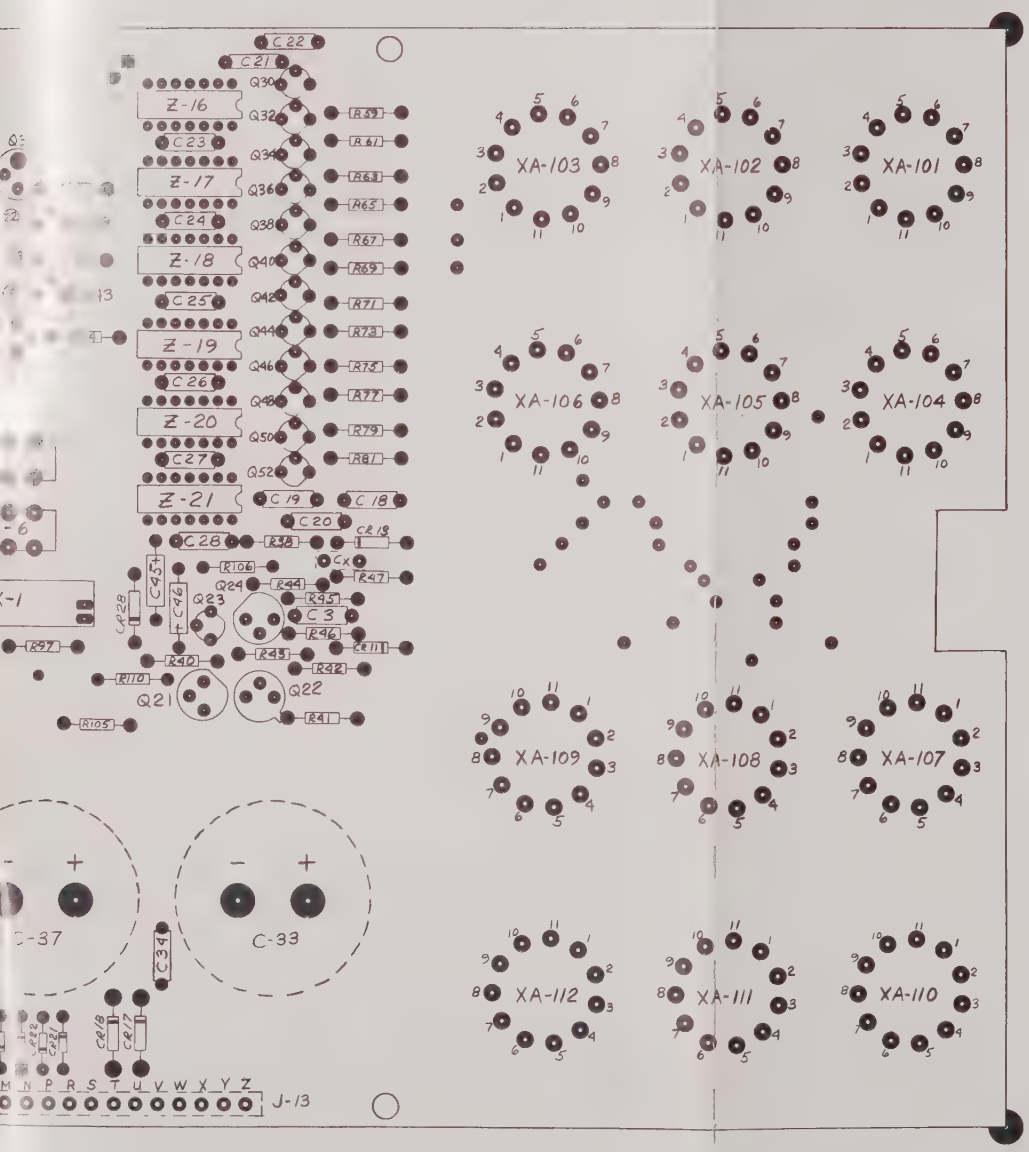
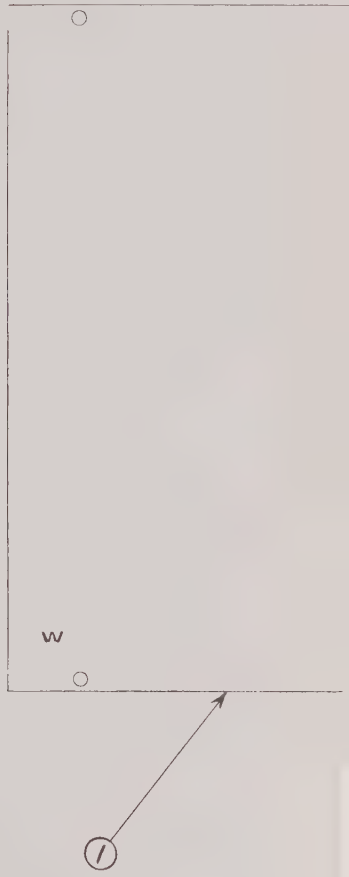


Figure 37. Master Circuit Board Assembly (855-437851, Rev B)


W
1

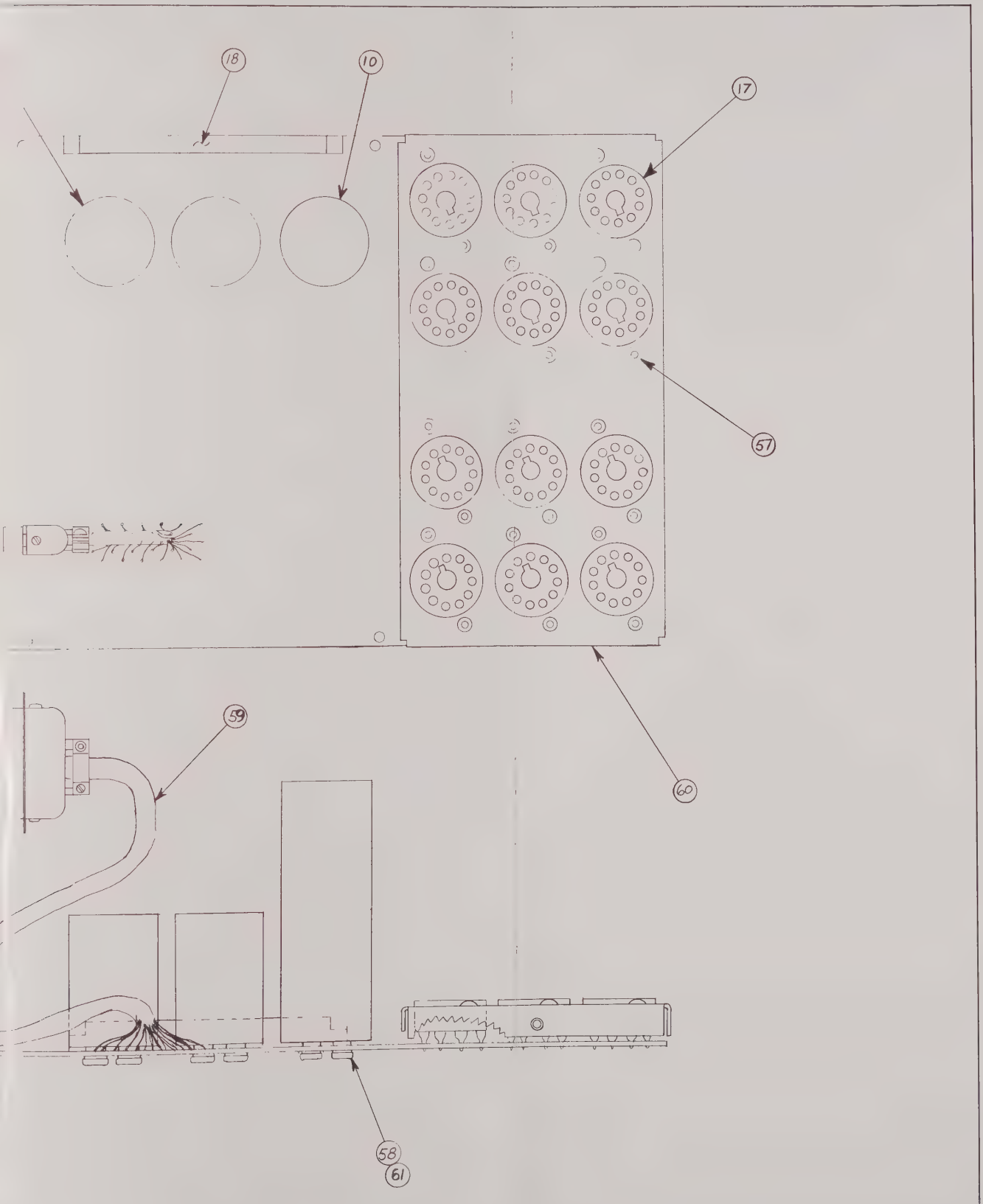
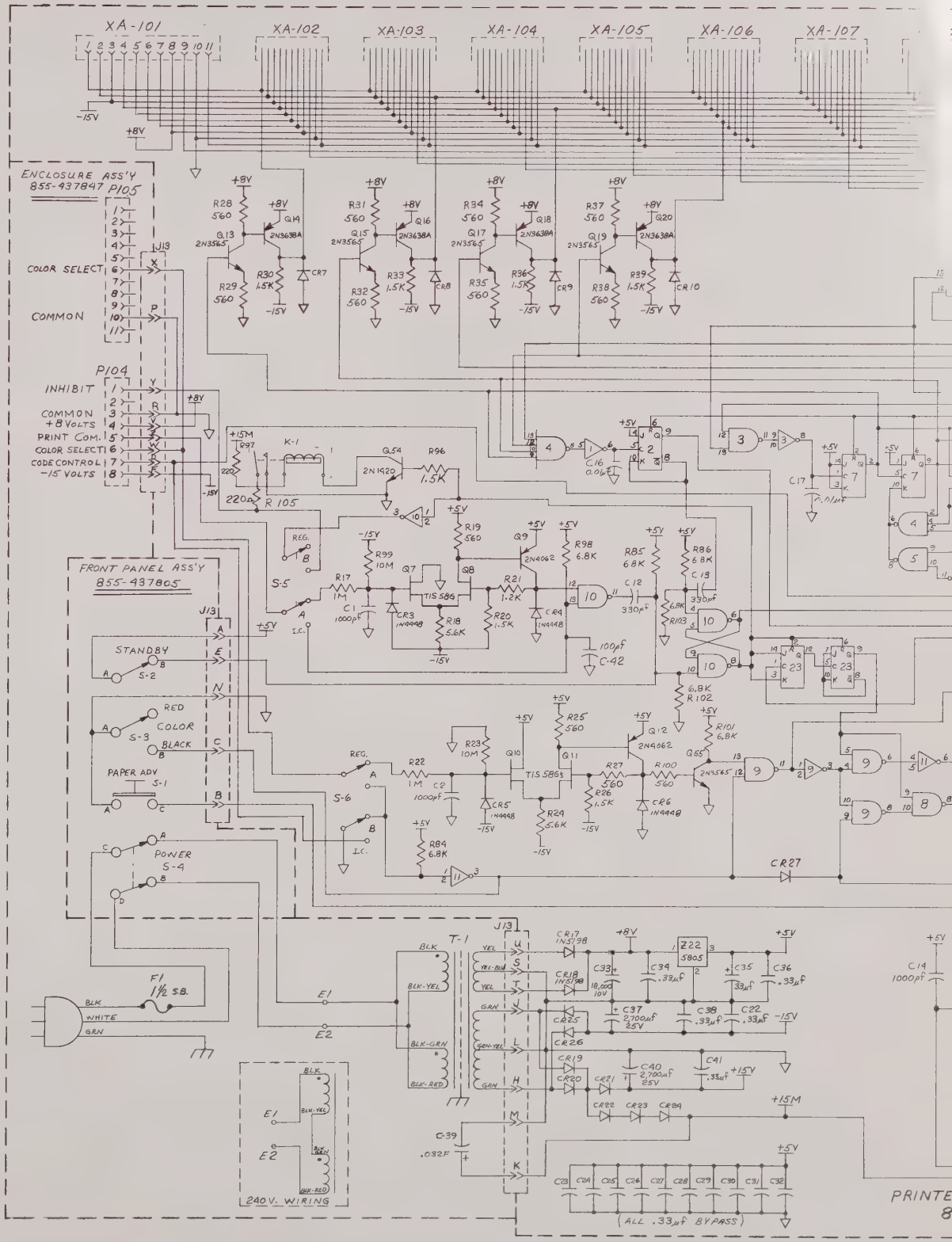


Figure 37. Printed Circuit Board Assembly Digital Printer (855-437851, Rev A)


XA-101
XA-102
XA-103
XA-104
XA-105
XA-106
XA-107
ENCLOSURE ASS'Y 855-437847 P105
P104
COLOR SELECT
COMMON
INHIBIT
COMMON +8 VOLTS
PRINT COM.
COLOR SELECT
CODE CONTROL
-15 VOLTS
FRONT PANEL ASS'Y 855-437805
STANDBY
S-2
RED
COLOR
BLACK
S-3
PAPER ADV
S-1
POWER
S-4
S-5
S-6
REG.
I.C.
K-1
R 105
T-1
F1
1½ SB.
BLK
WHITE
GRN
E1
E2
240 V. WIRING
BLK-YEL
BLK-GRN
BLK-RED
YEL
YEL-BLU
GRN
GRN-YEL
CR27
(ALL .33μf BYPASS)
PRINTE
8

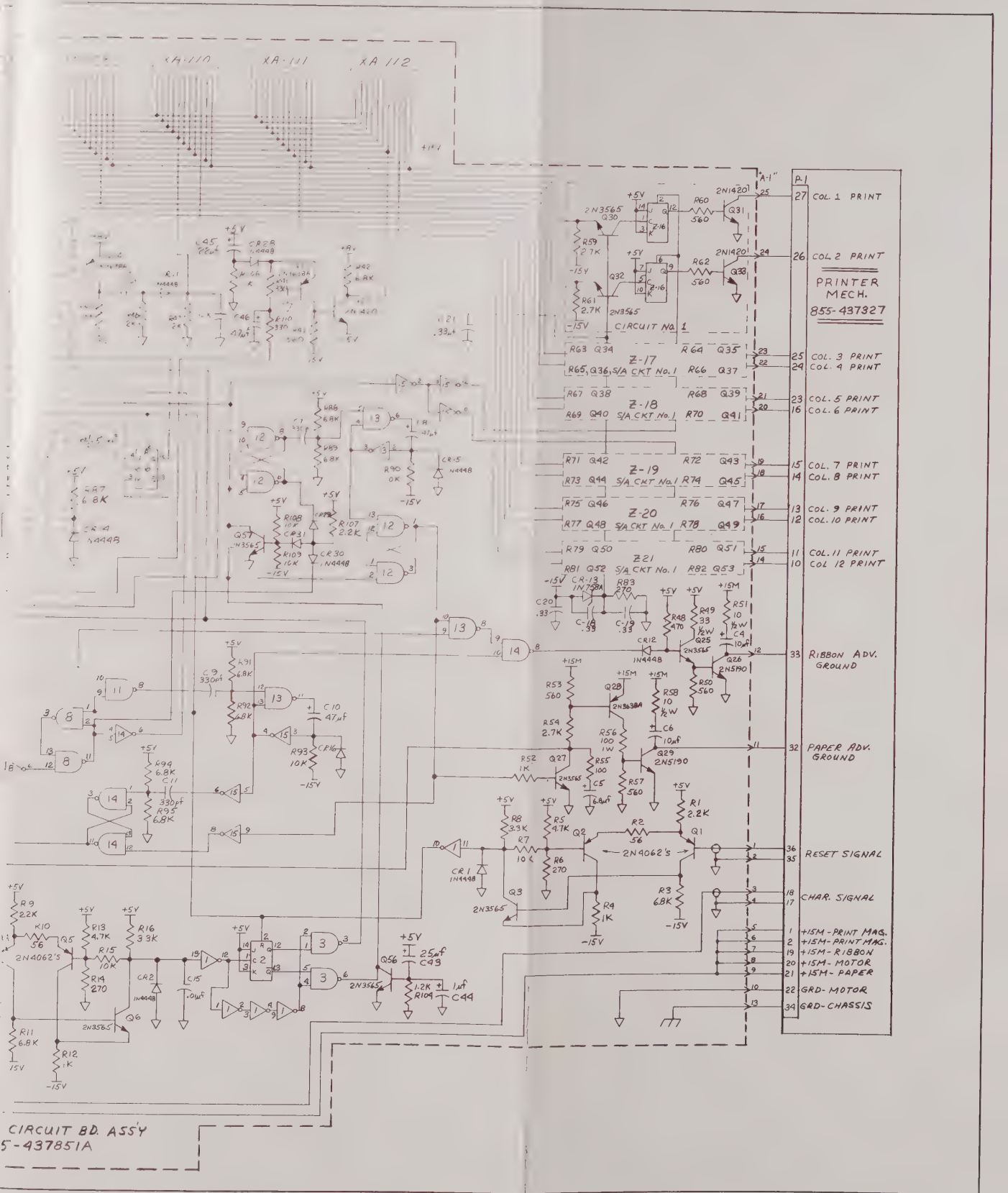


Figure 38. 1453B Digital Printer, Schematic Diagram

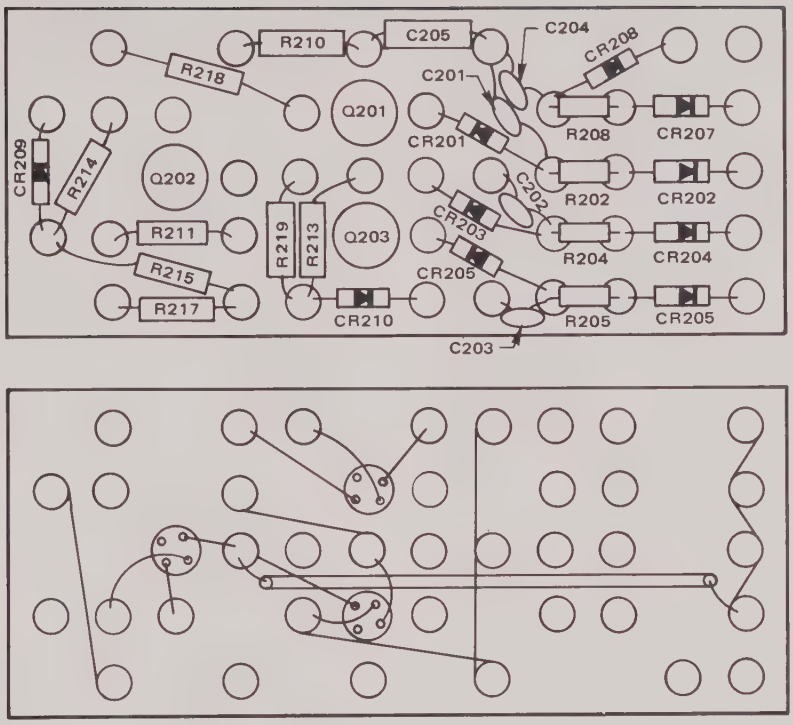


Figure 39. Four-Line Input Module Assembly (855-404474, Rev A)

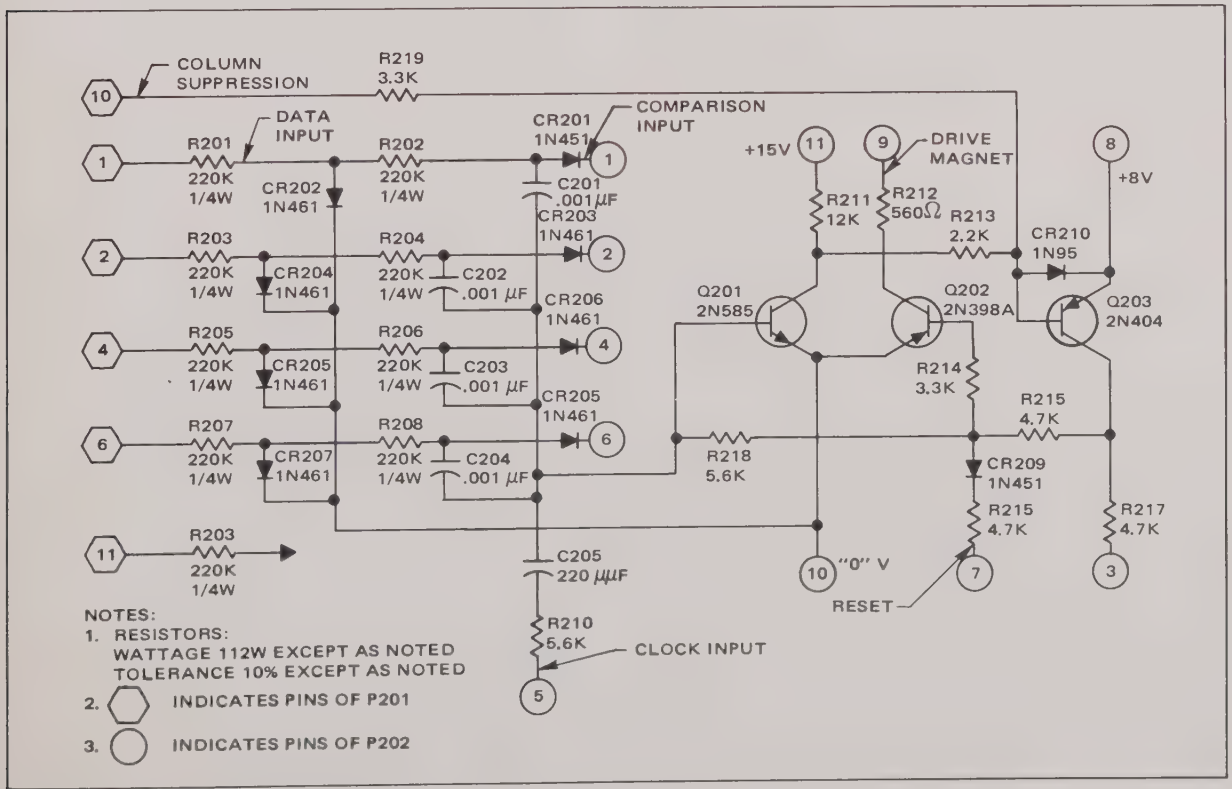


Figure 40. Four-Line Input Module, Schematic Diagram (020-404461, Rev D)

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
		855-404476	Ten-Line Module Board "A" (Figure 42)	Beckman	
		855-404478	Ten-Line Module Board "B" (Figure 43)	Beckman	
	C301 thru C308, C310	633-804706	Capacitor, Ceramic Disc., 0.001 μF, 1 KV	Centralab DD-102	9
	C309	637-804765	Capacitor, F. Mica. 220 pF, 500V, 5%	Sangamo RR1322	1
	CR301 thru CR323, 325, 326	755-404593	Diode, Silicon	Beckman	25
	CR324	755-402107	Diode, Selected	Beckman	1
	P301, 302	678-806896	Plug, 11-pin, (Header)	Amphenol 86-CP11	2
	Q301	755-800415	Transistor	G.E. 2N585	1
	Q302	755-817800	Transistor	Motorola, 2N3984	1
	Q303	755-800398	Transistor	Sylvania, 2N404	1
	R301, 302, 304 thru 319, 329	601-812742	Resistor, F.C., 220K, 1/4W, 10%	Allen Bradley, CB2241	19
	R303, 324	601-010684	Resistor, F.C., 3.3K, 1/2W, 10%	Allen Bradley, EB3321	2
	R320, 325	601-008085	Resistor, F.C., 5.6K, 1/2W, 10%	Allen Bradley, EB5621	2
	R321	601-008089	Resistor, F.C., 12K, 1/2W, 10%	Allen Bradley, EB1231	1
	R322	601-008073	Resistor, F.C., 560 ohm, 1/2W, 10%	Allen Bradley, EB5611	1
	R323	601-008080	Resistor, F.C., 2.2K, 1/2W, 10%	Allen Bradley, EB2221	1
	R326, 327, 328	601-008084	Resistor, F.C., 4.7K, 1/2W, 10%	Allen Bradley, EB4721	3
	S301	716-812753	Switch, Slide, DPDT	Oak Mfg. Co., Type 78	1

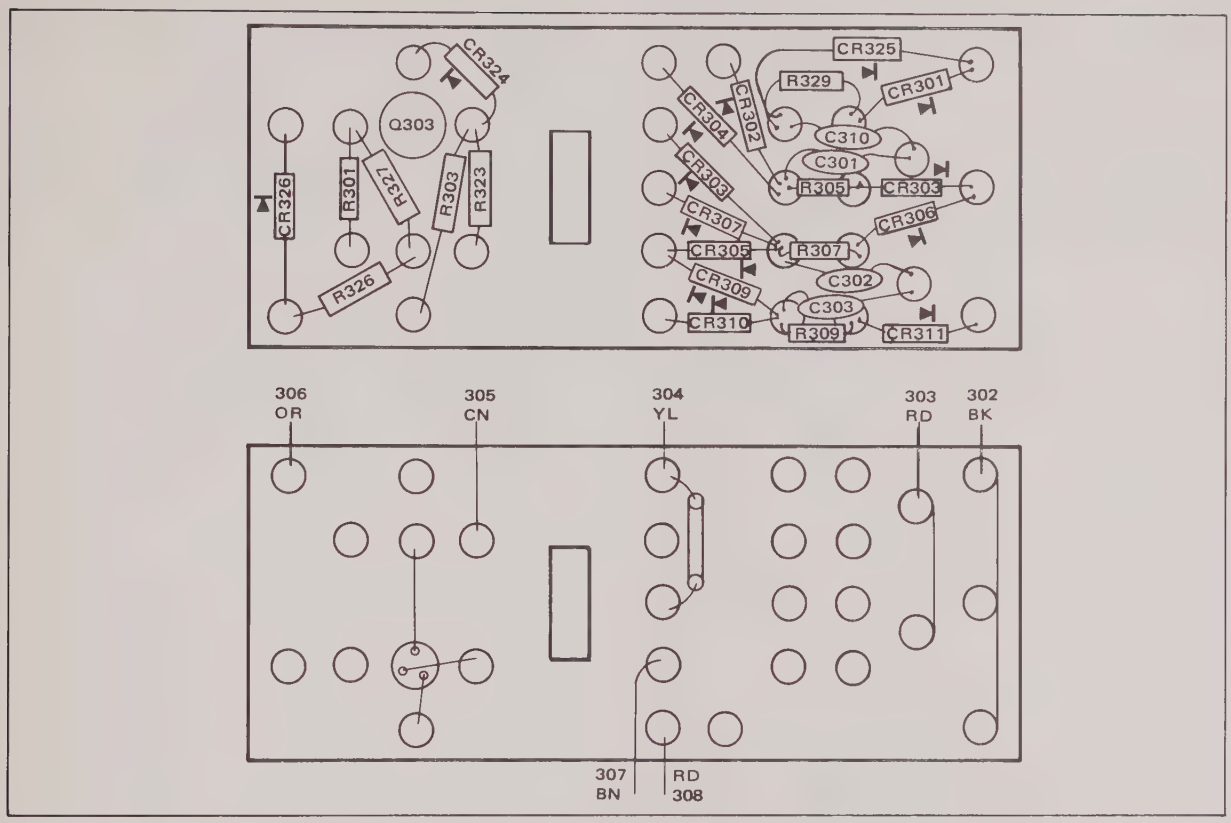


Figure 41. Ten-Line Input Module Assembly "A" (855-404476, Rev A)

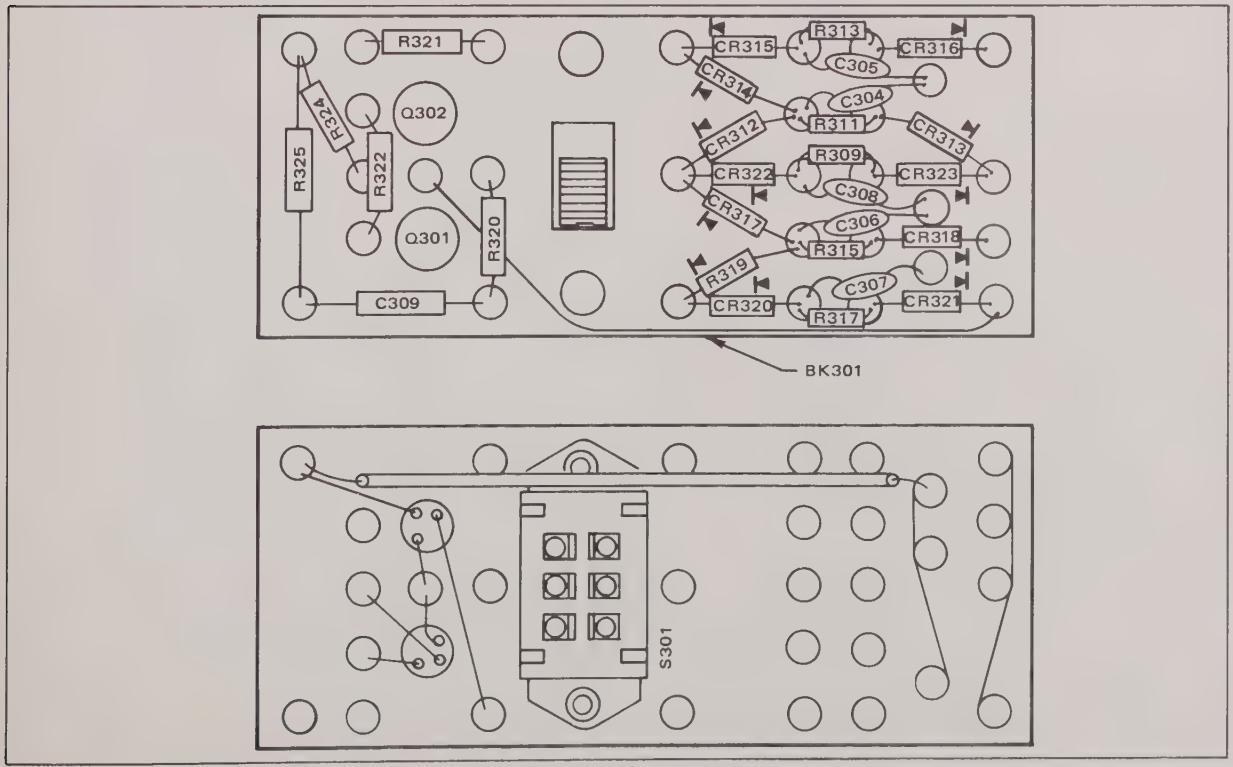


Figure 42. Ten-Line Input Module Assembly "B" (855-404478, Rev C)

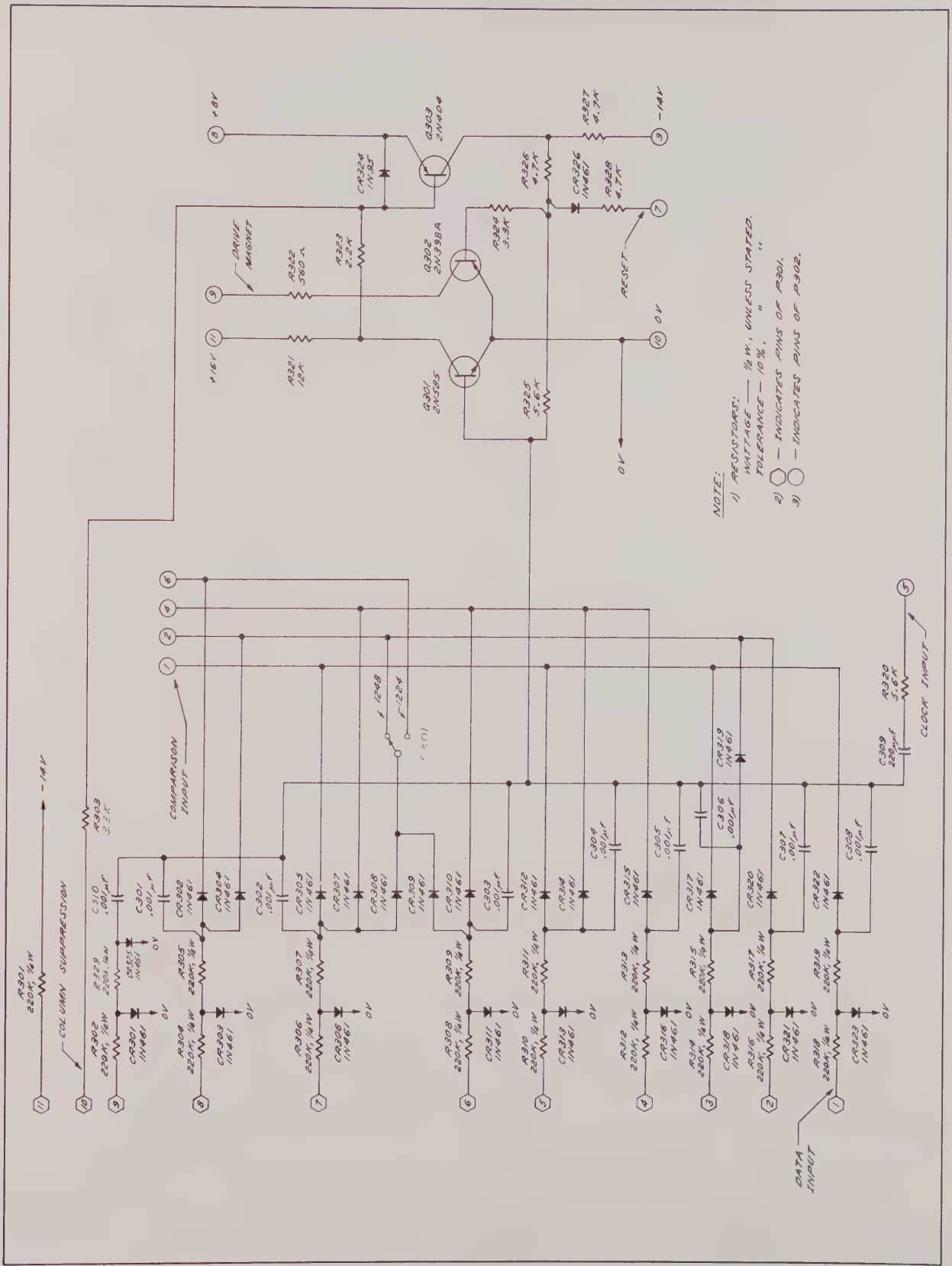


Figure 43. Ten-Line Input Module, Schematic Diagram (020-404454, Rev B)

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
	C1 thru 4	637-822757	Capacitor, 0.001 μF, 100V, 5%	Electromotive DM15-F102J0-100WV4CR	4
	C5	637-804765	Capacitor, 220 pF, 500V, 5%	Sangamo CM15-E221J03	1
	CR1 thru 5	755-838731	Diode	Continental Devices, 1N4448	5
	CR6	755-402107	Diode, Special	Beckman	1
	Q1 thru 4	755-846416	Transistor	Fairchild, 2N4248	4
	Q5	755-800415	Transistor	G.E., 2N585	1
	Q6	755-817800	Transistor	RCA, 2N398A	1
	Q7	755-800398	Transistor	Texas Instruments, 2N404	1
	Q8	755-851412	Transistor, Special	Beckman	1
	R1 thru 4	601-812741	Resistor, 100K, 1/4W, 10%	Allen Bradley, CB1041	4
	R5 thru 8	601-823962	Resistor, 560K, 1/4W, 10%	Allen Bradley, CB5641	4
	R9 thru 12	601-819675	Resistor, 130K, 1/4W, 5%	Allen Bradley, CB1345	4
	R13 thru 16	601-812742	Resistor, 220K, 1/4W, 10%	Allen Bradley, CB2241	4
	R17, 18	601-008085	Resistor, 5.6K, 1/2W, 10%	Allen Bradley, EB5621	2
	R19	601-008089	Resistor, 12K, 1/2W, 10%	Allen Bradley, EB1231	1
	R20	601-008073	Resistor, 560 ohm, 1/2W, 10%	Allen Bradley, EB5611	1
	R21	601-008080	Resistor, 2.2K, 1/2W, 10%	Allen Bradley, EB2221	1
	R22, 28	601-010684	Resistor, 3.3K, 1/2W, 10%	Allen Bradley, EB3321	2
	R23, 24, 25	601-008084	Resistor, 4.7K, 1/2W, 10%	Allen Bradley, EB4721	3
	R26	601-823934	Resistor, 270 ohm, 1/4W, 10%	Allen Bradley, CB2711	1
	R27	601-823937	Resistor, 680 ohm, 1/4W, 10%	Allen Bradley, CB6811	1
	Z1	885-846627	Integrated Circuit	Motorola, MC846P; or Texas Instruments, 5N15846N	1
		864-811098	Transistor Pad	F.P., 603090	4

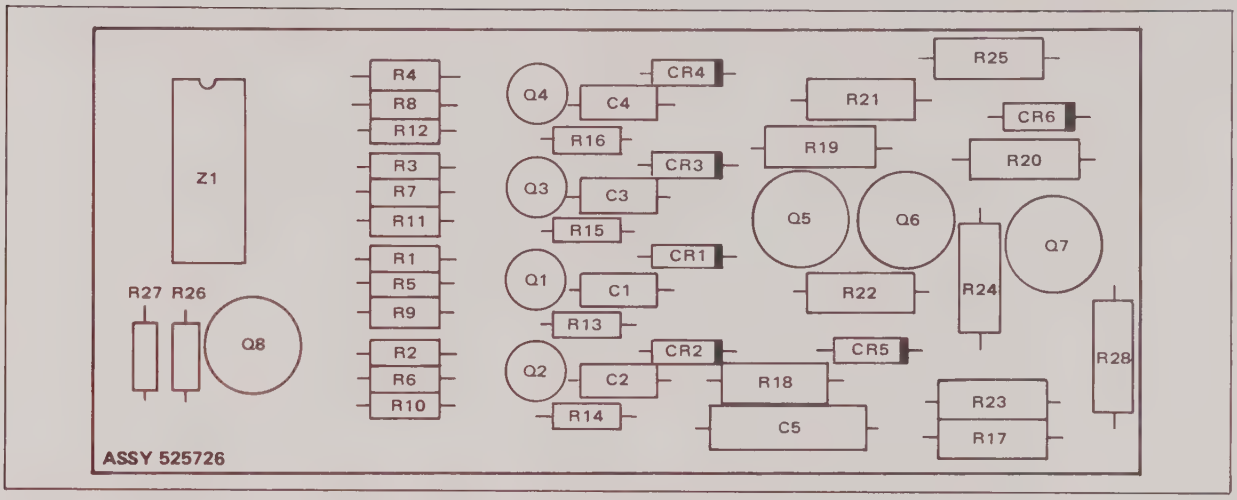
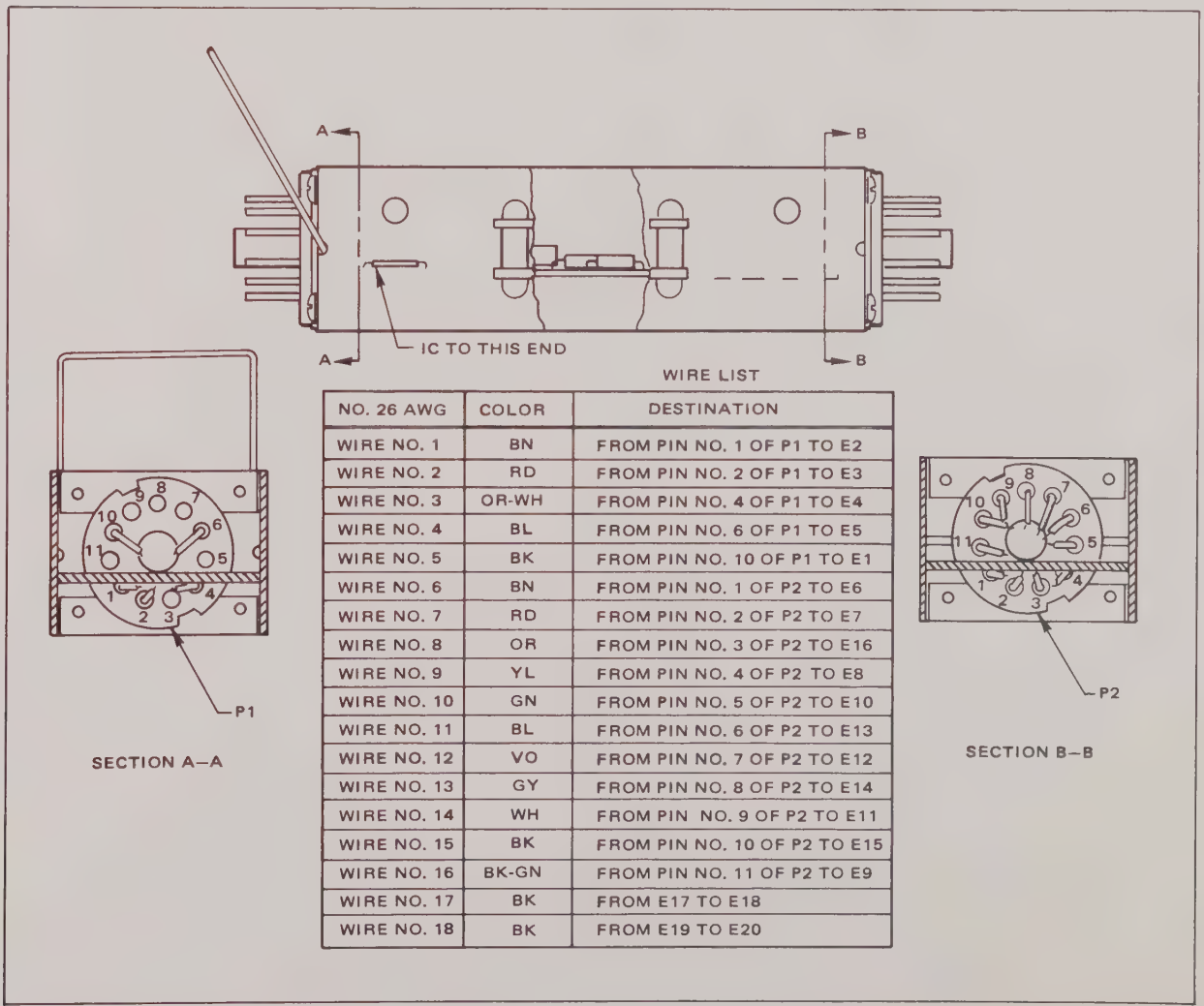


Figure 44. IC Input Module Circuit Board Assembly (855-525726, Rev C)



WIRE LIST

NO. 26 AWG	COLOR	DESTINATION
WIRE NO. 1	BN	FROM PIN NO. 1 OF P1 TO E2
WIRE NO. 2	RD	FROM PIN NO. 2 OF P1 TO E3
WIRE NO. 3	OR-WH	FROM PIN NO. 4 OF P1 TO E4
WIRE NO. 4	BL	FROM PIN NO. 6 OF P1 TO E5
WIRE NO. 5	BK	FROM PIN NO. 10 OF P1 TO E1
WIRE NO. 6	BN	FROM PIN NO. 1 OF P2 TO E6
WIRE NO. 7	RD	FROM PIN NO. 2 OF P2 TO E7
WIRE NO. 8	OR	FROM PIN NO. 3 OF P2 TO E16
WIRE NO. 9	YL	FROM PIN NO. 4 OF P2 TO E8
WIRE NO. 10	GN	FROM PIN NO. 5 OF P2 TO E10
WIRE NO. 11	BL	FROM PIN NO. 6 OF P2 TO E13
WIRE NO. 12	VO	FROM PIN NO. 7 OF P2 TO E12
WIRE NO. 13	GY	FROM PIN NO. 8 OF P2 TO E14
WIRE NO. 14	WH	FROM PIN NO. 9 OF P2 TO E11
WIRE NO. 15	BK	FROM PIN NO. 10 OF P2 TO E15
WIRE NO. 16	BK-GN	FROM PIN NO. 11 OF P2 TO E9
WIRE NO. 17	BK	FROM E17 TO E18
WIRE NO. 18	BK	FROM E19 TO E20

Figure 45. IC Input Module Top Assembly (855-525701, Rev B)

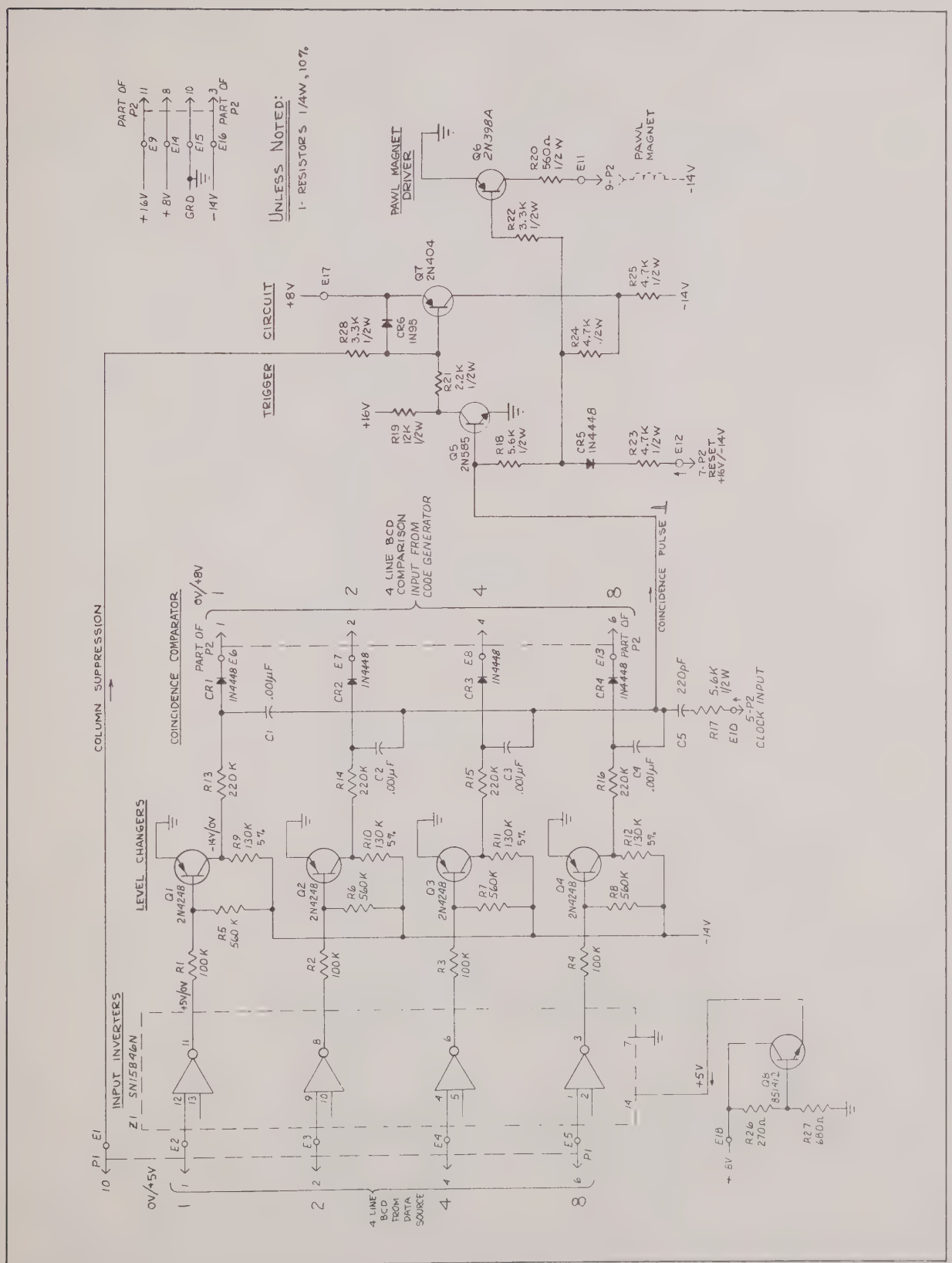


Figure 46. IC Input Module, Schematic Diagram (020-525727, Rev C)

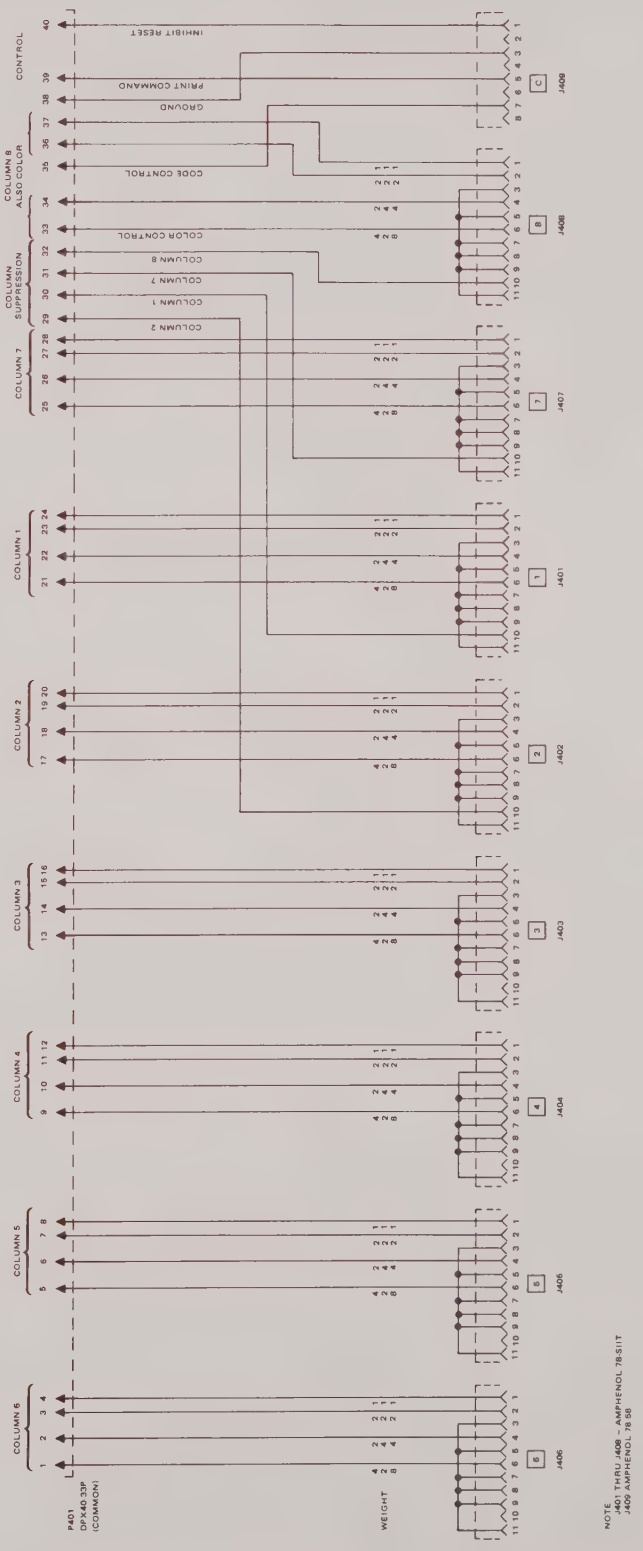


Figure 47. Four-Line Input Cable, Schematic Diagram

FOUR-LINE INPUT CABLE PARTS LIST (MODEL 6401)
(664-437166, Rev. A)

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
		860-011948	Socket, 11-Pin	Amphenol 78-S11T	8
		860-029566	Socket, 8-Pin	Amphenol 78-88	1
		672-814648	Connector and Hook Assembly	Amphenol 57-30500	1

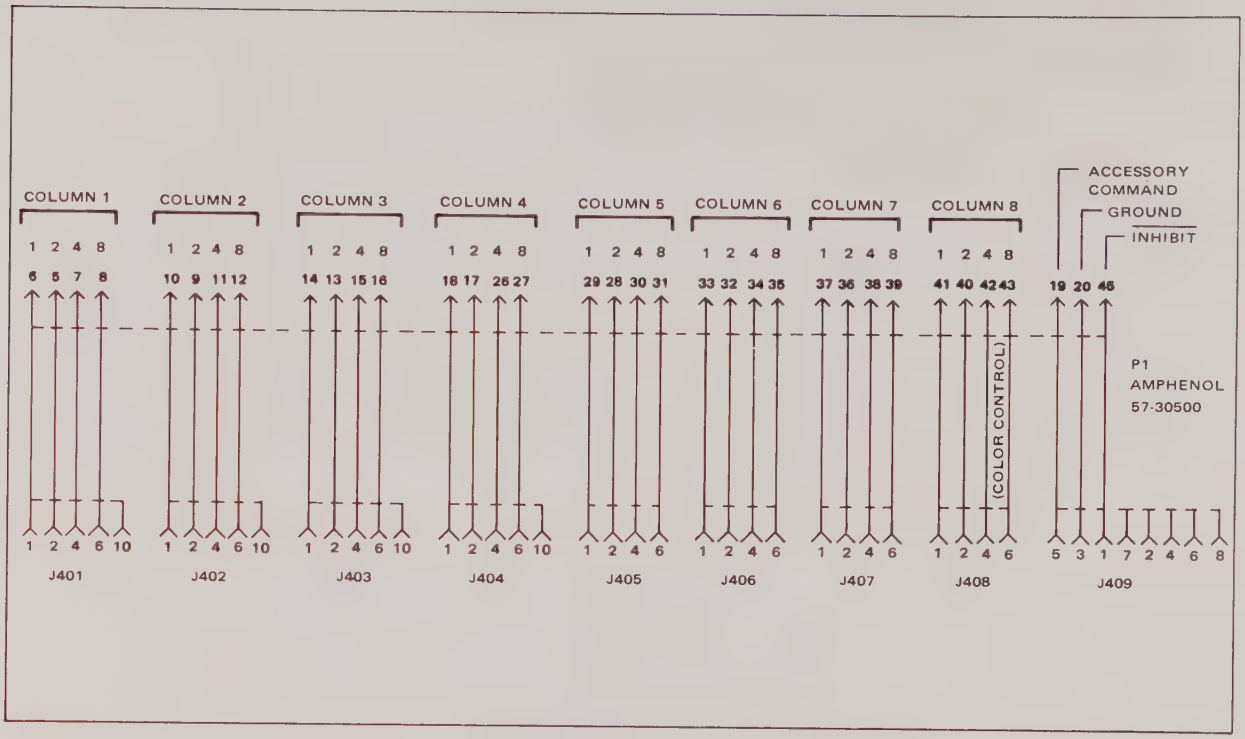


Figure 48. Four-Line Input Cable (8 column), Schematic Diagram (020-436067, Rev B)

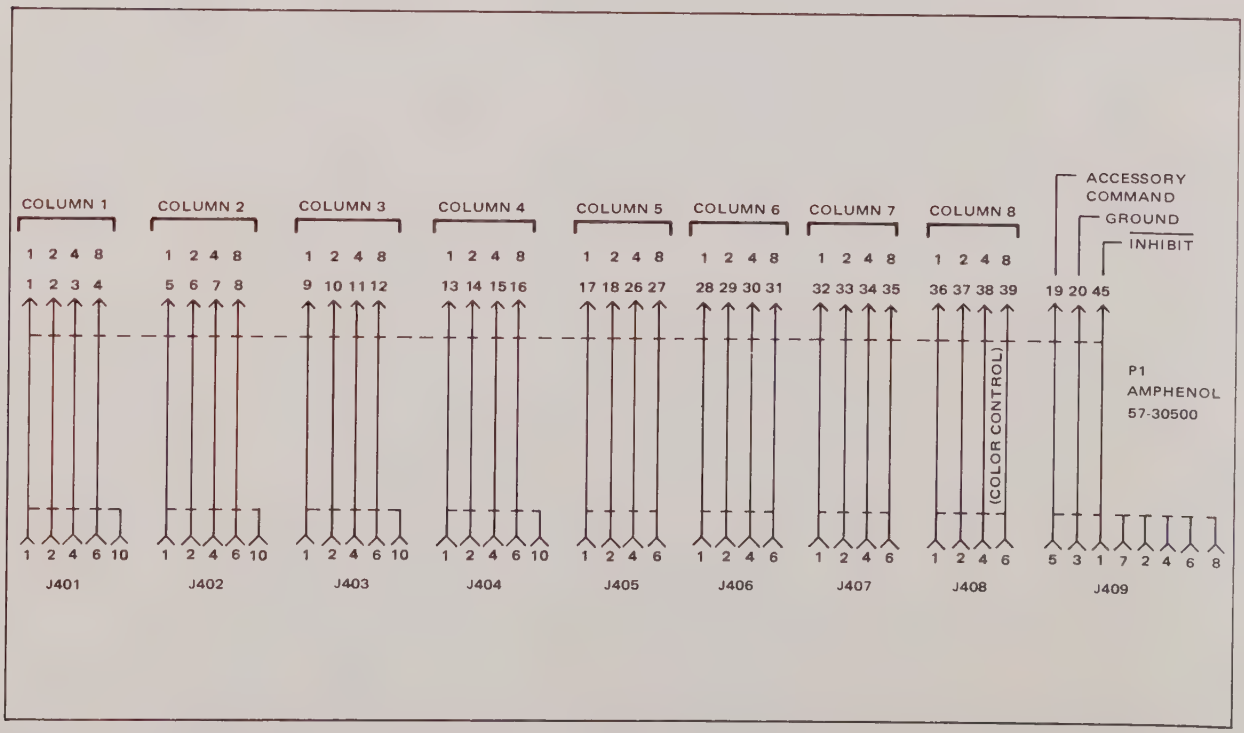
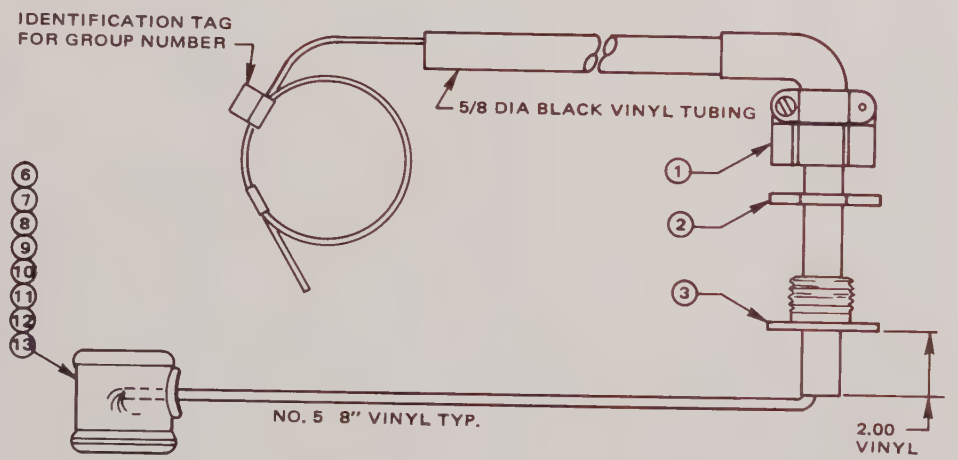


Figure 49. Four-Line Input Cable (For 6401 Counter), Schematic Diagram (020-437168, Rev A)

ITEM NO.	REFERENCE DESIGNATIONS	BECKMAN PART NUMBER	DESCRIPTION	TYPICAL MANUFACTURER & NUMBER	QTY/ ASSY
1		697-806983	Connector, End Cable Clamp	Cannon, AN3057-10A	1
2		699-801709	Spacer Threaded	Cannon, AN3066-10	1
3		699-404566	Connector, Chassis Cable Retaining	Cannon, AN3064-10	1
4		860-029566	Socket, 8 Pin		1
5		860-011948	Socket, 11 Pin		7
6		697-404573	Hood, Silkscreen 1		1
7		697-404574	Hood, Silkscreen 2		1
8		697-404575	Hood, Silkscreen 3		1
9		697-404576	Hood, Silkscreen 4		1
10		697-404577	Hood, Silkscreen 5		1
11		697-404578	Hood, Silkscreen 6		1
12		697-404579	Hood, Silkscreen 7		1
13		697-404585	Hood, Silkscreen C		1



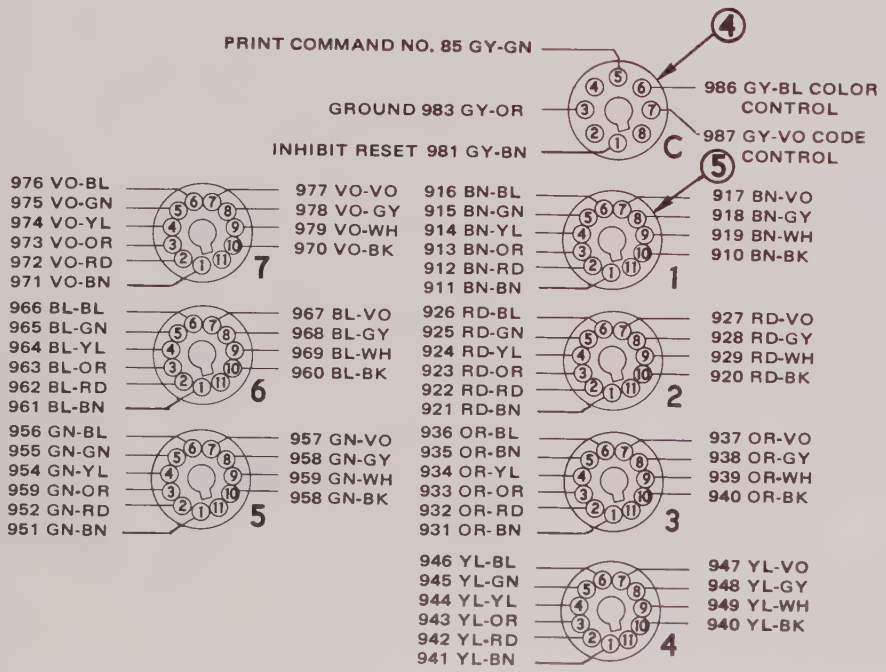


Figure 50. Ten-Line Input Cable Assembly, Wiring Diagram, and List (020-405888, Rev B)

TEN-LINE INPUT CABLE WIRE LIST

	WIRE NO.	COLOR
GROUP 1	910	BN-BK
	911	BN-BN
	912	BN-RD
	913	BN-OR
	914	BN-YL
	915	BN-GN
	916	BN-BL
	917	BN-VO
	918	BN-GY
	919	BN-WH
GROUP 2	920	RD-BK
	921	RD-BN
	922	RD-RD
	923	RD-OR
	924	RD-YL
	925	RD-GN
	926	RD-BL
	927	RD-VO
	928	RD-GY
	929	RD-WH
GROUP 3	930	OR-BK
	931	OR-BN
	932	OR-RD
	933	OR-OR
	934	OR-YL
	935	OR-GN
	936	OR-BL
	937	OR-VO
	938	OR-GY
	939	OR-WH
GROUP 4	940	YL-BK
	941	YL-BN
	942	YL-RD
	943	YL-OR
	944	YL-YL
	945	YL-GN
	946	YL-BL
	947	YL-VO
	948	YL-GY
	949	YL-WH

	WIRE NO.	COLOR
GROUP 5	950	GN-BK
	951	GN-BN
	952	GN-RD
	953	GN-OR
	954	GN-YL
	955	GN-GN
	956	GN-BL
	957	GN-VO
	958	GN-GY
	959	GN-WH
GROUP 6	960	BL-BK
	961	BL-BN
	962	BL-RD
	963	BL-OR
	964	BL-YL
	965	BL-GN
	966	BL-BL
	967	BL-VO
	968	BL-GY
	969	BL-WH
GROUP 7	970	VO-BK
	971	VO-BN
	972	VO-RD
	973	VO-OR
	974	VO-YL
	975	VO-GN
	976	VO-BL
	977	VO-VO
	978	VO-GY
	979	VO-WH
GROUP C	981	GY-BN
	983	GY-OR
	985	GY-GN
	986	GY-BL
	987	GY-VO

6.1 GENERAL

Three types of Input Code Modules are available for the Model 1453B: a four-line module for BCD data of 1-2-2-4, 1-2-4-2, and 1-2-4-8 weighting, a ten-line module which accepts both ten-line and four-line data, and an IC Input Code Module to handle IC input logic levels.

Both 1-2-4-2 and 1-2-4-8 code weights are the same for the Model 1453B. Each module plugs into any of twelve sockets, numbered 1 through 12, which correspond to the positions of the digit columns. A maximum of twelve digits of coded data can be plugged into the modules in any order. By connecting the individually numbered connectors on the input cable to a particular module, the digits can be arranged in any order on the printed line.

6.2 FOUR-LINE INPUT CODE MODULE

This Input Code Module is a solid-state device comprising a coincidence comparator CR201 through CR208; a two-stage trigger circuit Q201, 203; and a pawl magnet driver Q202. Refer to schematic in Section Five.

Clock pulses are applied to the trigger circuit through an attenuator. The attenuation factor is high when any coincidence diode (CR201, CR203, CR206, or CR208) is conducting, and low when all four diodes are non-conducting. Four lines of BCD data are applied to the anodes of the diodes from the external input source; four lines of similarly coded data are applied to the cathodes from the code generator. As long as the decimal digits represented by the two data sources are different, at least one of the diodes will conduct. Therefore, the clock pulses are attenuated to about +5 volts — too low to affect the trigger circuit. During this quiescent condition, the trigger is in RESET, keeping Q202 on. Since the collector of Q202 is returned to -15 volts dc through a load resistor, the signal will be "0" so "NOT" print magnets are triggered.

When input data and position data coincide, all four diodes are non-conducting. A clock pulse arriving at coincidence has enough amplitude to switch the trigger circuit to the other state, turning off transistor Q202 and allowing the signal to set the pawl driver flip-flop. This flip-flop turns on the print magnet driver for one character of the drum. The flip-flop is then reset by a timing signal.

Removing an Input Code Module removes the signal needed to set the pawl driver flip-flop. This column suppression feature automatically insures that data will not be recorded in any digit column that does not have an Input Code Module. Column suppression can also be controlled remotely by a contact closure to power ground from one pin on the top connector of any module.

6.3 TEN-LINE INPUT CODE MODULE

The ten-line Input Code Module uses a diode matrix which first translates the decimal input data into four-line BCD data, weighted 1-2-2-4 or 1-2-4-8 according to the position of a switch on the module. The remaining circuit is the same as that of the four-line module.

Since the ten-line Input Code Module accepts both ten-line data and BCD data, a printer fitted with these modules is able to record both types of information on one line.

6.4 IC INPUT MODULE

This IC Input Module is used for integrated circuit logic level and is housed in the same mechanical package as the other Input Code Modules. A schematic diagram is included in Section Five.

The DTL flatpack (Z1) consists of four inverting NAND gates which serve to buffer the input lines and to provide some noise rejection. An input logic level of 0 to +0.45 volt holds the NAND gate outputs at +5 volts. This keeps the level changer transistors (Q1 through Q4) turned off and thus presents -14 volt inputs to the coincidence comparator. This is equivalent to a logic zero in the case of the standard module.

A +2.5 to +5.5 volt NAND gate input produces a zero or grounded output to the level changer. This causes the level changer transistors to conduct and present a 0 volt input to the coincidence comparator.

Therefore, the logical inputs to the IC Input Module are: a logic zero = 0 to +0.45 volt (the signal source must be capable of producing 1.6 milliamperes at these voltage levels); a logic one = +2.5 to +5.5 volts (the leakage current into the input terminal is a maximum of 5 microamperes at these voltage levels).

Power for the DTL flatpack is derived from the +8 volts available on the module input connector. The +8 volts is applied to an emitter follower which has a resistor divider between collector and base. The ratio of R66 and R27 is set to provide a +5 volt output at the emitter of Q8.

To operate this module with inverted logic, i.e., a logic one = 0 to +0.45 volt and a logic zero = +2.5 to +5.5 volts, the DTL flatpack (Z1) can be removed and jumper wires inserted between pins 1 and 3, 4 and 6, 8 and 9, and 11 and 12 of the flatpack.

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